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VOL. XXIX MARCH, 1931 No. 3

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## EDITORIAL

### DEMONSTRATION FORESTS

THE idea of "demonstration forests" to portray the application of forestry under commercial conditions is not new but its execution is painfully slow and inadequate. True, we have huge areas of national and state forests upon a portion of which various types of silviculture are being practised, but because of special conditions they can hardly be accepted as commercial examples, and while we have made a good start toward demonstration forests operated by schools, the effort is far from adequate. The weakest side of our adult forestry education scheme is our lack of sufficient gallery space to which we can take those to whom we want to demonstrate our art.

Demonstration forests should have for their major purpose the application of forestry methods so circumscribed or free from frills as to be well within the confines of commercial limitations. They should show not only methods but profits as well, and a set of accounts that are readily understood by the interested. This does not mean that a demonstration forest cannot serve a several-fold purpose such as a laboratory for research (provided the research does not interfere with the major purpose and that the accounts are kept properly), or as an instruction area for forestry students so that they can see classroom theory tested in practice.

Demonstration forests are urgently needed in every sub-region and in sufficient numbers to cover the major problems of private ownership. We need some on areas where rehabilitation is the major problem, some on areas of good volunteer growth, and others on areas still covered with virgin timber. In each case there should be included with the problems of silviculture those of varying tax systems and utilization standards. It is doubtful if the owner of severely denuded lands requiring planting will be much impressed by demonstration areas, because it takes such a long time to show anything in the way of profitable growth. On the other hand a demonstration forest on an area of good volunteer second-growth would show results very quickly and would provide an example for independent pri-

vate owners to copy or at least to use as a guide. On such lands the forester has an excellent opportunity to apply high-grade silviculture although he has at the same time an acute utilization problem to tax his ingenuity to make his operations pay. Thanks principally to a few interested benefactors, we have some excellent demonstration areas, in fair volunteer growth or culled old-growth, and operated in most cases by forestry schools. They have proved their worth although it cannot be said that they are anywhere near adequate in scope or purpose. They are too few in number, usually small, and too frequently the forestry operations are not solely of a commercial order. Our very best demonstration forests are those operated on a full scale by a few private owners scattered principally in the South, the Lake States and the Northeast.

Profit in forestry in the eastern half of the United States is dominated by cheap lumber from virgin forests. According to some foresters the virgin timber of the West is an obstacle to the practise of forestry in the East. It would seem that the removal of such an obstacle would be welcomed. Yet it is the virgin forest whose passing we have noted with concern. Furthermore it is, foresters believe, the method of handling these virgin forests that increases the area of denuded land. It would appear then that the *most* urgent need for demonstration forests is in our *virgin* timber to demonstrate orderly systems of management that leave the uncut trees to go on where the oldgrowth left off. Why wait for the virgin forests to be culled or denuded indiscriminately before starting to show what can be done with them? It is difficult to understand why those who most decry the passing of the virgin forest should not go vigorously after opportunities to test and demonstrate the commercial feasibility of forestry. Is it a challenge they fear to accept?

The private owners are too generally regarded as obstructionists. It is highly questionable, however, if their antagonism is based on disbelief in forestry principles or on resentment toward efforts to force them into a practice, the feasibility of which cannot be demonstrated by samples. The past has proven that private forestry cannot be advanced by lecturing or legislating alone. It needs among other things the actual trial and practice *by foresters* under the realities of business practice to determine what limits of silviculture can be practiced and then to use the trial or practice areas as demonstrations or examples. It should not be difficult to obtain the confidence of private owners if they can be shown successfully operated sample forests.

With such an enormous area of forest land in this country, much more than we need if it were all producing to capacity, and with wood opposed by many substitutes, whether for lumber or cellulose, it is not too easy to show a profit. At a recent meeting of foresters interested in actually operating demonstration forests in the East it was said that a successful forest, as shown by their sample areas, must be operated under rigid economy, that its capitalization and its carrying charges must be low,

and that there must be close integration between silviculture and utilization. Profitable forestry, on private lands therefore being no easy task, there is all the more reason for more actual applications of the theories for use as demonstrations. European forestry was recently described as being distinct from ours in that it is a forestry of economics and silviculture, while ours is one of propaganda. Until we can point to *many* profitably operated demonstration units our great forestry effort will remain only mildly effective.

# THE SOCIETY COMES OF AGE[1]

By RAPHAEL ZON

*Director, Lake States Forest Experiment Station*

American forestry, as a profession, is thirty years old. Its progress, accomplishments and influence upon national life are an American epic. A whole historic epoch has been crowded into thirty years. Through its leaders, apathy toward conservation has changed to interest and support. The author, one of the charter members of the Society, gives in a scholarly address a refreshing account of the development of forestry and the forestry profession. Likewise, he gives a thought-provoking admonition to the American people to take stock of their plans for the future in forestry and other national matters. We need a new faith in our own destiny more than a new freedom.

I DO NOT KNOW of any country in the world which has made a more marvelous and rapid progress in forestry than the United States in the 30 years between 1900 and 1930. This is not an oratorical gesture, nor an attempt at hyperbolic statements, pardonable as they may be at birthday celebrations. It is an actual fact.

A whole historic epoch is crowded into this 30-year period. Within the last 30 years we have witnessed the birth and the development of one of the greatest national movements—the movement for conservation. It marked a revolutionary change in our traditional, age-old public land policy. Within this period we saw the rise of a new profession—the profession of forestry.

The pioneering spirit, the daring, the enthusiasm, the sacrifices, all lend an almost romantic atmosphere to this period, and make it truly an American epic. To do justice to it would take the pen of a Milton or the eloquence of a Clay or Burke.

Our Society came into being at the beginning of this period, and its members were the shock troops in the battle for conservation. Being a cross section of the entire profession, it is the best yardstick and barometer for gauging the growth of forestry in this country.

## Achievements of Forestry

The record of our achievements, if we look at them not too closely with the natural impatience of zealots, but from a distance of 30 years ago, is very impressive.

1. Out of a neglected and rapidly dissipating public domain, some 156 million acres have been set aside as national forests and put under management. Some four million acres were added by purchase or exchange. We have today one-fifth of all the forest land in public control, almost as much as in some European countries, and more is being added through acquisition or exchange at the rate of some half million acres per year.

2. Orderly management was brought

[1]Address delivered at the birthday dinner, 30th annual meeting of the Society of American Foresters in Washington, D. C., December 30, 1930.

out of the chaotic condition of millions of acres of our western range, which now provide forage for nearly 8 million cattle and sheep.

3. Tolerable fire protection is now provided for four-fifths of all forest land.

4. Practically every state in the Union has now a state forest department, which maintains a fire protective system and makes some effort at restocking denuded lands. New York is now entering on a most ambitious forest program which contemplates the expenditures of some $20,000,000 in 15 years.

5. Forest planting is progressing at the rate of some 100,000 acres a year.

6. Forest taxation laws, to encourage forest practice, by private owners, have been passed in a number of states.

7. Over 31 million people enjoyed the recreational facilities of the National Forests last year.

8. The number of professional foresters in three decades has risen from a half a dozen to over 2500, and from one or two forest schools at the beginning of the century, we have now 25.

9. We have produced a forest literature that is beginning to command the respect of the world, and our JOURNAL OF FORESTRY is an outstanding professional organ.

10. We have overcome the indifference of the large masses of the people to the conservation of natural resources. Our most bitter opponents of yesterday are our best friends today. And no movement has today as much popular support as forestry.

11. We have even broken into the citadel of the lumber industry. If we have not succeeded, yet, in converting the lumbermen to the practice of forestry, the idea of forestry does not seem to them now as impractical as it did a few decades ago. They are willing to use the best brains of the profession—to be sure only the best brains—in the solution of their own problems. A number of pulp and paper mills are seriously looking to forestry as a means of providing their future raw materials, and a few lumber companies, even, are playing with the idea of reforestation and selective logging.

## THE GROWTH OF FORESTRY KNOWLEDGE

These are the tangible public accomplishments. On the intangible side, the technical growth and the accumulation of knowledge, progress was no less significant.

As a computer 30 years ago on the 8th floor of the Atlantic Building, I used to prepare volume tables based on the tree diameters alone, involving simplest arithmetic. Today, the most expert mathematical thought and analysis are applied to the determination of the volume of trees. The volume of the tree, if it is not a frustrum of a cone it is a mathematical expression of the ratio between the diameter breast high and the diameter half way up the tree. Several formulas are used to determine the accuracy of the volumes. If the aggregate difference, for instance, is two and one-half times more than the average deviation divided by the square root of the number of observations, the tables are discarded as unreliable.

The preparation of yield tables used to be a pretty simple process. Today, it

is a most solemn ritual which makes the head of an old timer swim. If you do not refer to coefficient of alienation, Charlieu's Series A and Series B, differential equations, multiple correlations, and even spurious correlations, you are just a nobody, just a simpleton who does not belong.

The old timers were interested only in a few simple curves, and they were not always of the mathematical kind. Today, even youngsters just out of school glibly talk of all kinds of curves, parabolic, hyperbolic, exponential, harmonized, and anamorphous.

Everything must be correlated. Not long ago one of those keen young forest mathematicians referred to one of our laws of growth as being a spurious correlation. I thought at first of getting offended. It sounded as if we were being accused of putting over something that was not so. But when it was explained to me that spurious correlation is a perfectly legitimate mathematical correlation, except that it is spurious, I was satisfied that our prestige had not suffered.

Even if we old timers have at times a sneaking suspicion, undoubtedly because of our own backwardness, that these young mathematicians do not know any more than we do, we must admit that it is a long, long road from simple arithmetic to differential equations and Charlieu's Series A and B.

And this is true of every other branch of forestry. How much did we know of botany, plant physiology, and soils 30 years ago? Today, we have foresters who can call every little living plant in the forest and every blade of grass on the range by its first name. They can tell you exactly how and why the sap rises 250 feet to the top of the Douglas fir. Their sharp eyes can tell at a glance from the character of the vegetation alone, the type and the profile of any soil to a depth of four and even more feet.

Verily, forestry in 30 years has risen from the lowly level of the cow-puncher and the lumber jack to the position of a most profound science. Some foresters now breathe the same rarefied air as Milliken, Clements, John Merriam, and other Olympians, and literally rub elbows with them.

Thirty years ago, when a Forest Supervisor had a grammar school education, he was looked upon by his associates with some suspicion as being over educated. Today, a large number of forest rangers modestly conceal the fact that they are holding degrees of Master of Forestry from the best institutes of forest learning in this country. And one or two forest rangers, I understand, can even put a Ph.D. after their names.

## The Changing Public Attitude Toward Forestry

If, 30 years ago, you proudly proclaimed to a newspaper man that you were a forester, the chances were that you would see a reference to yourself as a member of the Exalted Fraternal Order of Forresters, with two r's. Today, a forester, in his own name with one r, is known in the remotes hamlet of our country and, I suspect, even in the halls of Congress.

Thirty years ago, foresters were looked upon as cranks, subject to ridicule. They had practically no influence

in the counsels of our government, federal, state, or local. Today, we have foresters as governors of great commonwealths, and, who knows, a forester may soon hold the highest position in the land. We have foresters in the halls of Congress, foresters as great philanthropists, great educators, authors—even contributors to the *Saturday Evening Post*, captains of the movie industry, economists, chiefs of bureaus, great administrators, colonels and majors by the score, and captains without number. Now, a small group of men which can produce from among its own midst in such a short time such a large number of useful citizens must possess the qualities of mind and soul and must have the fiber of which true leaders are made. If there is, therefore, any profession in this country, which, because of its public record, can look any man straight in the eye and tell him to go to hell, it is the forestry profession.

Tonight is the foresters' festival. We celebrate tonight the vindication of the foresters' ideas. A small group of young, enthusiastic men and women, inexperienced in the affairs of the world and business, had the prophetic vision and the courage to live up to it. The economic and historic march of events has proved that their ideas were sound and practical. There is no room for any gloom or pessimism in the ranks of foresters. The economic and social forces of the world are working with them, and I am as certain, as that day follows night, that in another 25 or 30 years forestry will be firmly enthroned, not only in the minds of the people but actually in the woods.

At times, some of us become infected with the gloom that now permeates the lumber industry. We, of course, sympathize with the difficulties of a great and basic industry. But the lumbermen's difficulties are to a large measure of their own making. The specter of a diminishing per-capita consumption of wood that is haunting the lumber industry, its fear of increase in the use of substitutes for wood, and also its apprehension that there may be an over-production of forest products can not be part of a defeatist psychology of foresters who know history and can intelligently interpret the economic future.

### Wood in no Danger

The need for wood, and especially forests, will last as long as the human race on this planet. Countries like Sweden and Finland, whose very existence depends upon the products of the forest, are not worrying that there may be too much forest but are continuously improving the old forest and planting new.

If one would believe our cellulose chemists, the age of lumber is passing, and its place is being taken by wood fiber and cellulose. In spite of all these predictions, pulpwood still constitute only 6 or 7 per cent of our total annual cut. It may be that, in the distant future, their predictions may come true, but for generations yet lumber will be the most highly prized product of the forest.

All our calculations for future needs for forest products deal with domestic needs. In practically every other field of industrial endeavor, production far exceeds our domestic needs. Why

should we confine ourselves in timber production only to our domestic needs? We have here on the North American continent the finest plant for growing timber found anywhere in the temperate region, the largest number of useful species of any country in the world. Yet, we are satisfied to work this plant only to a fraction of its capacity and are willing to surrender the production of this world-wide needed commodity to such countries as Sweden, Finland, Russia, and Canada, the bulk of whose forests lie within the Arctic Circle, and which have at most half a dozen species to work with.

Wood is the most elastic organic matter and can be moulded in a thousand different shapes and forms. Human civilization, more and more, depends upon organic matter. The pronouncements of chemists, at times bombastic, that eventually everything will be produced synthetically, overlooked the fact that even for synthetic products organic matter is necessary as raw material. They may produce artificial silk, but they need the fiber of wood for that purpose. They may produce generator gas, but they need the carbon of organic matter stored by plants either in past geologic epochs or in modern times.

How much carbon do you think chemists could extract directly from the air, without the help of growing green plants, for the synthetic manufacture of all the carbohydrates? Mighty little. Organic matter, whether synthetically produced from other raw organic materials or derived directly from the plant itself, is the basis of our civilization. All that the chemists can do is to modify one raw organic material into another organic product of a more finished, useable form. As a matter of fact, the future looks to the chlorophyl engineers, as President Wilbur once so well expressed, to foresters and to other growers of plants for the substance of life.

Another famous engineer once defined the green plant as the binder of energy, the animal as the binder of space, and man as the binder of time. The greatest moving force in the entire world is energy, and it must come eventually from the green plants and, above all, from the forest as the highest expression of plant life.

## Social Benefits of the Forest

Foresters, however, are not concerned merely with the material product of the forest. Forests are an important factor in the climate of the world. They regulate water and save soil. They are the home of wild life and the lungs—the breathing spaces—and playground of mankind.

There is another aspect of forestry which even surpasses all other benefits. This is the future of our countryside.

Not long ago, more than 50 per cent of our people were engaged in agriculture and lived in the country. Today, only 20 per cent of our population are on the farms. With ample machinery, 15 per cent of the population are enough today to produce all the food that is required, and 10 per cent properly educated farmers could do it. In the last 10 years, 4,000,000 people have left the land; 19,000,000 acres have gone out of cultivation, and 76,000 farms have ceased to exist as farms.

If 90 per cent of our people are going

to live in the big cities and only 10 per cent on the land, I believe there is a great peril to life and to the quality of our future citizenship. Go to the Lancashire factories of England, or any other big industrial city of Europe or America, observe the shriveled, anaemic, and bloodless people, the third generation of city-bred folks. Humanity is like the ancient legendary giant, Antaeus, who drew strength from touching the earth. A city population, which has lost contact with the earth for several generations, has no likeness to the noble Adam, the father of all humanity.

If only 10 per cent of the population are to live outside the cities on farms, what is to become of the unlimited vastness of our land? If not agriculture, what else, except forests.

There is even a greater significance to the maintenance and upbuilding of our forests, and with them all our primary natural resources, that goes to the heart of our future economic existence. We are reaching an impasse in our national economic situation, which at this moment is very acute. Like King Midas, whatever we touched has turned into gold, and yet we are starving, surrounded by mountains of gold.

### New Faith is Needed

There is over-production in practically every line of industry, even in agriculture. Our mill capacity is larger than the amount of products that can be consumed. The machine age, by introduction of new machinery and improved technique, is replacing men, both in the factory and on the farm. These displaced men and women can not enter new productive fields. In the last 10 years some 500,000 people were replaced by machines alone in the factories, and probably a similar number on the farms. They seek employment in the field of personal service, in garages and in service stations. Some become near parasites, and many enter upon lives of actual crime.

As their purchasing power is decreased, the market for the products of the factory and farm is also decreased. And here is the paradox. The greater our technical progress, both on the farm and in the factory, the graver becomes the economic situation.

And what is the answer? A new outlet must be found for the surplus capital, whose reinvestment in over-expanded industry only adds to over-production and aggravates the situation. At times we hear expressions like: "Oh, if only a new industry would arise on the horizon, an industry similar to the automobile industry of 25 years ago." This would release the accumulated capital, place the large number of unemployed in productive occupations, and revitalize the whole economic structure. Capital is now seeking investment in foreign fields. The most absurd doctrines are being propounded like the doctrine of waste, according to which the products of the factory must be used up, worn out, and wasted as fast as they are produced, or the doctrine of the production of luxuries, and similar economically unsound panaceas.

Yet, the outlet for our accumulated surplus capital and human energy is right at home—right at our own doors—if we only had leaders in our economic

and industrial field who had the vision to see it and grasp it.

This outlet lies in diverting the surplus capital and surplus human labor into repairing and building up our primary natural resources. We went through this continent as an invading army, pitched our tents, built our Main Streets just long enough to skim the cream and waste the rest. We have destroyed our forests; we have almost exhausted our mines; we have depleted most of the fertility of our soils and allowed it to be washed away; we have disfigured the beautiful landscape of our country; we have polluted our rivers and turned them from objects of utility into sources of menace to life and property.

We have been on this continent now for over 150 years. Frankly, this is not a bad country. As a matter of fact, there is no better country in the world. Then, why not at last get settled, not for another hundred years, but for a thousand or two thousand years. Let us begin to build for permanency; let us build for beauty; and let us develop here a culture that will surpass the culture of ancient Greece and Rome.

While the productive power of man has been increased many fold, the productive power of nature has been throttled, crushed, and reduced to insignificance. We have built, and are still building, one of the greatest industrial structures in the world, on a foundation that is continuously becoming smaller and weaker. We can not go on like this. Other countries are arising on the historic horizon which have rich unimpaired natural resources. If these countries borrow our industrial technique, our economic supremacy may be readily challenged. That country will prove the victor in this economic struggle which has used its primary basic resources most conservatively and intelligently.

If we can divert our surplus capital and labor into these neglected fields—which are the basis of our industrial greatness—, new opportunities for productive labor will be opened to millions of people, their purchasing power will be greatly increased, sub-marginal farm lands will be removed from the market, the rewards for agricultural labor will be greatly increased, the balance between factory and farm will be restored, and the farmers will again become the largest consumers of the products of the factory.

We must revise our old slogans and courageously abandon worn-out shibboleths which in their own times may have served a good purpose. In this country, we do not need so much a new freedom as a new faith in our own destiny, a new patriotism, and a new love for the country. Unless we get this new faith, I am very much afraid that we are headed toward economic stagnation and social troubles.

Our economic salavation lies, to a large extent, in diverting large sums of money into the reforesting of our cut-over land, in the control of floods, in the improvement of our rivers, in stopping erosion, in restoring the fertility of the land, in developing water power for the benefit of all the people, in the building up of our institutions of learning, research, social welfare, and culture.

As a matter of fact, what do we do in an economic crisis like this but appro-

priate large sums of money for public works to start the wheels of industry moving? These works, started under economic and often political pressure, are often hastily conceived and poorly planned. What we are trying to do hurriedly at a time of crisis should become the regular, premeditated, definite policy of the Government—federal, state, and local.

You may say, yes, this is true, but does it not mean largely public enterprise? To a great extent, yes, but there are also fields open for private enterprise under public supervision and with public assistance.

Take, for instance, the field of forestry. An analysis of the income tax returns of our industries,—not in a year of depression but in a fairly good year, in 1926 for instance, shows that the total assets of our big industrial corporations amounted to some 250 billion dollars. The net returns on these assets were about 8 billion dollars, or about 3 per cent.

Why, there is no forest in this country, except possibly the swamp forest of the northern Lake States, which is not earning through growth alone, without the effort of man, from 2½ to 3 per cent.

It is pathetic to watch how the lumber industry of the Pacific Northwest is trying desperately to liquidate its assets in the Douglas fir forests. The industry has a mill capacity in that region of some 14½ billion feet. It can actually market only 8 billion feet, and it has a stand of timber in private hands that will last from 30 to 40 years. Carrying charges and taxes will bankrupt the industry long before the assets can be liquidated. It can not be done. It can no more be done than if the people of the District of Columbia would attempt all at once to liquidate their houses by trying to sell them. Convert these assets into permanent investments and earn 3 per cent—and this means forestry—and the whole economic complexion of the lumber industry is changed.

Forestry played an important part in awakening the public conscience into the conservation of natural resources. It has performed a gigantic task. But what we have done so far pales into insignificance compared with what is ahead of us. Conservation of natural resources is no longer a mere theory, a sentiment. It is today an economic necessity; it is almost a question of economic life or death.

At such a time, how ridiculous it is to worry over whether we may have too many forests, whether forestry will pay or not. We foresters have a big part to play in the economic salvation of our country. If we tackle this problem with the same devotion, the same enthusiasm, and the same faith that we have had in the past, we will perform a social service and will retain for this country the justly earned fame as the promised land, as the land of hope and opportunity for the common man.

# RELATION OF THE NATIONAL FORESTS TO A POLICY FOR THE UNAPPROPRIATED PUBLIC LANDS[1]

By R. Y. STUART

*Chief Forester, U. S. Forest Service*

The Chief Forester contrasts briefly the benefits derived from administering the national forest lands according to a sound policy and the problems created by the lack of policy toward our public domain. Under the basic policy in effect for national forest administration the permanent usefulness of the lands is safeguarded, while the unappropriated public lands are greatly depreciated by abusive practices. The test of jurisdiction to be applied to unappropriated public lands is whether or not they serve a national purpose so distinctive as to warrant their retention by the federal government, or in the absence of such benefit how they can best be brought to their highest use. The Forest Service sees in the unappropriated public lands a stewardship to be redeemed.

THE CONSERVATION movement in this country had its origin in forest conservation. It was conceived in the spirit of good stewardship to fellow and future citizen. It was given life with the vigor of a fixed conviction—to accomplish public good. Its most marked impetus was the setting aside of forest reserves by the federal government, later crystalizing in the designation of these tracts as national forests and in provision for their protection and administration.

The national forests have been forest conservation's proving ground. Every conceivable method has been tried over the years to test the soundness of their public purpose and worth. Veritable battles have been waged against the principles and methods of their administration. While large contributory support came to the movement from other agencies, federal and state, which in increasing number exemplified or sustained forest conservation, the failure of the national forests would have been a serious setback.

Constructive work on the national forests had its beginning in 1905, when well defined objectives of administration were laid down. Legislatively the mandate of Congress in the Act of June 4, 1897, was simply to protect these forests from fire and depredations and to provide for their controled use while preserving the forests. Concerning the forms and methods of use to be permitted the law said very little, while concerning objectives of control nothing was indicated beyond the broad objectives of improving and protecting the forest, securing favorable conditions of water flow, and furnishing a continuous supply of timber for the use and necessities of citizens of the United States. The administrative authorities, therefore, were vested with very wide discretion to regulate use and determine purposes. The vision and sagacity of the early administrators of the national

[1]Presented at the 30th annual meeting of the Society of American Foresters at Washington, D. C., December 29-31, 1930.

forests is attested by the fact that the basis for administration laid down by them is responsible in large measure for the subsequent favor of the national forests with the public and to the measure of service they have given.

From the start these properties have been administered for the fullest and highest public use to which their resources can be put. Thus the principle was fixed that forest officers must deal intelligently not only with the timber and water resources on these forests but with the utilization of them and other resources, such as are represented by game, livestock, various forms of occupancy, and recreation, not as independent resources but as coördinated means for promoting the public welfare to the maximum degree possible.

Grazing control presented an urgent and outstanding problem to be faced in applying this principle. Grazing use of the forests was actually going on. It was by far the chief use then being made of them. It dated from long before the lands were set aside from the open public domain. It was essential to the range livestock industry of the West. It could not have been stopped without very serious consequences. The law said nothing about it.

All that the law said was that the forests were to be preserved from destruction and their occupancy and use was to be regulated. Obviously regulation must, for one thing, prevent the destruction of the forests, and uses irreconcilable with preservation of the forests must be stopped. Uncontrolled grazing had done great damage to the forest. Many people believed that at least the grazing of sheep on the reserves was inconsistent with forest preservation. What course should be taken, and at what should regulation aim?

The Secretary of Agriculture's letter of February 1, 1905, gave the answer. All the resources of forest reserves were for *use:* all land was to be devoted to its most productive use for the permanent good of the whole people; the water, wood, *and forage* of the reserves were to be conserved and wisely used; and where conflicting interests must be reconciled the question was always to be decided "from the standpoint of the greatest good to the greatest number in the long run". The objectives of control were thus laid down. It was to seek the largest net total of public benefits, present and future, to the people of the entire United States, through public management which alone could insure harmonized development of all the resources involved.

Because the national forests were going enterprises, regulation had to be applied in advance of the accumulation of knowledge and experience adequate to guide and govern use most wisely. The two outstanding administrative problems thrust upon the Forest Service at the outset were fire control and range management. Both were virgin fields. Obviously without protection the management of the forests would be hazardous or of little avail. The protection task was so large that, with the limited number of men and crude facilities available, it absorbed the bulk of forest officers' thought and effort. Over the years there have developed on the national forests and elsewhere techniques in dealing with the forest fire problem. With no background of experience and accomplishment upon which to draw, it has been necessary in this country to

build up in a short time and on a gigantic scale systems of forest protection which are giving increasing measure of security to national forests and other forest investments. A similar development has gone on in the technique of timber management and range management. Both of these have of course involved watershed management. From the standpoint of the relation of the national forests to a policy for the unappropriated public lands, the development of range management has the greatest significance.

As with the development of fire protection technique, the Forest Service had to tackle its job barehanded. There was little to go by. Range use had always been a form of wild-lands use. The idea of scientific range management had not been born. The plant associations making up the range, the life history of the numerous species, their relative palatability and nutritional value, the effects of interference through grazing of various degrees of intensity and at different seasons upon their rate of growth, reproduction, and ability to compete with other plants, the nature and significance of plant successions, the relation of the vegetative cover to run-off and erosion, the suitability of various types of range to use by the several classes of domestic stock—in short, the entire body of knowledge essential to an intelligent judgment as to how many and what class of stock to put on a given range, when to admit them, when to take them off, and how to handle them on the range was still to be brought to light. Our early workers were like explorers on uncharted seas.

The pioneers led the way to the new division of science which has been established—the science of range management and range livestock management. Chairs for its teaching have been created in universities and agricultural colleges; systematic research to develop it further has been provided for. Progressive western livestock men are keenly alive to its value and are conforming their practices to its conclusions. All this you know. The principles of range management form a part of the regular course of instruction in many schools for the training of professional foresters. As you are fully aware, the technique of range management and the technique of forest management have many points of similarity. Both require specialized training, experience and sound judgment for their successful application. If national forest administration has proved anything it has proved that range administration is a technical task, to be handled by experts. Any policy for the unappropriated public lands that does not insure the future use of such lands as are most valuable for grazing in accordance with the principles of sound management will fail to provide adequately for the public interest in their best utilization.

Technical education in forestry began in this country a comparatively short time before the national forests were placed under administration. Broadly speaking, the American profession of forestry and the administration of the national forests had their beginnings about the same time. In consequence what had been done was a mere beginning in forest management, forest utilization, range management, game management, and in the allied fields of forest entomology and forest pathology. Much remains to be done. To sketch the

progress made during the past 25 years in each of these fields and in the coördination of them goes beyond the scope of this paper. It has meant originality and dogged persistency in meeting the vast and varied problems of administration and use, with little to guide. It has meant intensification of effort to build up research, with its application to field practices, and the resulting development of a new technique in handling natural resources. Of even deeper significance and moment, it has meant the test of stewardship by the federal government within a field distinctly national although at the same time of far-reaching local and regional importance. It has been a test of the ability of government to efficiently conduct a business enterprise of national import.

The national forests have met the test. They have demonstrated that public land ownership for resource administration is feasible, that stewardship can be practically applied, and that expert administration of resources requiring the services of technicians to put them to best use can be built up and maintained. As a result the national forests are here to stay.

In the ownership and administration of forest properties serving a national need, the United States is following the proven course of older nations. National security and forest conservation are too closely akin to warrant complete federal dependence on forest perpetuation by other agencies. Large as the expectations and accomplishments in forest conservation of other public agencies and of private owners may be, there remains a distinctive national interest to be served and a national responsibility to be met. One of the questions that needs an answer in formulating a policy for the unappropriated public lands is whether in their case also important national interests are to be served and a national responsibility is to be met.

The operation of liberal public land laws has not brought these remaining public lands into private ownership for development and use. In the main they are admittedly greatly depreciated by abusive practices, adversely affecting not only the resources used and the citizens dependent upon these resources, but contributing to serious erosion problems. In recognition of a need for constructive action applicable to them, study is now being given by the President's Commission on Conservation and Administration of the Public Domain to determine the most appropriate disposition to be made of them and the resources they contain.

It is generally conceded that such of these lands as are actual or potential forest lands, adjacent or in close proximity to existing national forests, should be added to the national forests for protection, administration and development. These lands present practically the same problems as do their neighboring national forest lands. In most cases both are subject to common use or benefit as for timber supply, watershed protection, livestock, game or recreation. Frequently one area supplements the other in use, as for seasonal range or for the rounding out of a timber operation. It would consequently be advantageous for both proprietor and user to have them administered by the same agency.

A more difficult problem is that inherent in those lands which do not bear timber and are not adapted to timber growth, but whose highest use lies in

their watershed or forage values. Here also are resources to be conserved and values to be safeguarded. Range investigations have shown conclusively that under proper control similar areas have been used for grazing with more beneficial results to resource and livestock than under uncontrolled grazing. These investigations have also shown that under proper control similar lands, with but minor exceptions where exclusion of use is necessary, can be grazed without detriment to watershed values and without inducing destructive erosion.

The degree of control necessary to protect watershed values varies greatly. Under some conditions it is perhaps no greater than the self-interest of an intelligent landowner would naturally cause him to impose upon himself for the protection of grazing values. Under some conditions no watershed values of appreciable importance may be involved. But it should be remembered that the lands now in question have not been esteemed as worth enough to cause their private acquisition, under liberal land laws. Indiscriminate use has greatly decreased their productive capacity as well as lessened their soil holding qualities. Their recuperation and sustained productivity are contingent upon a proper adjustment of use to resource; and from the standpoint of highest use, or (what is the same thing) of the best public welfare, the first question is: What form of ownership will in the long run bring about the form and degree of control of use necessary to restore these lands to their full potential economic value?

The rehabilitation of overgrazed range necessitates a management directed by experts trained in the new science of range control. It is far from being an ordinary or simple matter. In some cases decades will be required to rehabilitate the land. Whatever may be true in the future after rehabilitation has been accomplished and as the range livestock industry assimilates and applies generally the new and improved methods, the development of the full economic value of the present public domain ranges for grazing purposes is in my judgment not to be hoped for without the setting up of some agency of public control of a thoroughly stable and highly competent character, directed by technicians.

It must be borne in mind that the character and amount of use must be adjusted to conditions which are constantly changing. For example, there are the inevitable periodic years of drouth that must be faced. It must be borne in mind also that the interests of the range user are affected by many outside matters, such as market conditions or financial obligations to be met. Except in rare instances the character of control of range use needful to bring back to productiveness the overgrazed and depleted public lands will not be obtained consistently through dependence upon private initiative. The individual is naturally responsive to periods of stress which create the alternative of the sacrifice of personal advantage or the sacrifice of the range. Under such circumstances the decision is customarily against the range. Adverse shocks can best be borne by a national or state agency acting in the interest of the long-range productivity of the resource.

The test of jurisdiction to be applied to these lands would seem to be whether in whole or in part they serve a national

purpose so distinctive as to warrant their retention by the federal government or, in the absence of a national benefit to be nationally developed, how they can best be brought to their highest use. Due to the scattered location of a material part of these vast areas, their varying worth and varying susceptibility of effective administration, no blanket-wide treatment of them seems practicable. It is clear from the character of them and the functions they can fill that they would not appropriately be designated as national forest lands. They are largely of both watershed and grazing type. The main consideration, however, is that they involve, as do the national forests, the need for good stewardship if they are to escape abuse and serve their highest purpose.

Having to do for many years with similar lands within the exterior boundaries of the national forests, the Forest Service has found it necessary in the interest both of the resource and the beneficiary to have applied to such lands measures of control which will adjust or coördinate the time, character and extent of use to the perpetuation of the resource. It believes that short of some form of public control by nation or state, more particularly for lands having a watershed protection influence, these areas will not only fail to fill their highest function but continue subject to abusive practices detrimental to the resource and to the public interest. It believes, with its national forest experience as a background, that constructive processes must be set to work, through the application of range management, in order to have both owner and user of the lands derive the maximum benefits consistent with the protective values they can afford against erosion. Their recuperation and sustained productivity are contingent upon proper adjustment of use to resource, with such inevitable conditions of use as constitute control or regulation.

The Forest Service sees in the unappropriated public lands a stewardship to be redeemed. It believes that the actual or potential resources on these lands should be safeguarded and developed. This is especially the case with those lands having a watershed protection influence. It follows that should the federal government retain these lands it should bring them under administration of the type which will, through the application of expert management, adjust use both to perpetuity of their resources and to the principle of the correlated development both of the range and of the water resource. On the other hand, should the federal government pass jurisdiction to the states for control it should do so with knowledge and pronouncement of the constructive purpose the lands can fill, nationally as well as locally, and with the announced willingness to assist the states in all practicable ways in their conservation of these resources, accompanied by stipulations that will be actually effective to insure conservation by the states. Transfer of jurisdiction will not change the problem or needs of the situation. The unappropriated public domain is a land problem to be solved. From the character, location and extent of the areas and from the public purpose they can be made to serve, the public is in a better position to solve the problem than private intiative. This has been amply demonstrated in connection with national forest administration of similar lands.

# UNITED STATES PUBLIC LAND POLICY
# A POINT OF VIEW OF A STATE[1]

By W. J. MORRILL

*State Forester, Colorado*

The author has circularized a number of western people who have knowledge of or an interest in the unappropriated public domain lands and he here reports their views concerning the transfer of such lands to the states. He found the foresters rather generally against their transfer and the state land boards largely of the opposite opinion. Whatever is done with these lands they should be given management designed to maintain their value permanently. The transfer, if effected, should be conditioned upon such handling by the new managers

SINCE THE assignment of the topic, President Hoover's Public Land Committee of which the Honorable James R. Garfield is chairman, has made a preliminary report. In view of this fact it has seemed best for me to present at this time the views of a number of western foresters, both state and federal, and of some members of several state land boards of various western states, as learned through correspondence and interviews during October and November.

State foresters and other foresters of the so-called public-lands states, believe, generally, that the federal government should retain its public domain, incorporating such timbered public domain into the national forests as is near them. They hold that the grazing lands, comprising nearly all of the 179,000,000 acres of unappropriated public domain, should immediately be organized and managed in some such manner as are the grazing lands within the national forests, and by the United States Department of Agriculture, or an equivalent, like the newly proposed Department of Organic Resources.

The state land boards of most western states desire that these lands be granted to the states, but only with the sub-surface rights going with the surface rights. Possibly a compromise on receiving the sub-surface rights on such areas as are not now known to possess sub-surface values might be acceptable, but this seems doubtful.

The State Board of Land Commissioners of Colorado is desirous of receiving the unappropriated public domain in Colorado, but only with sub-surface rights. Its views as to organized grazing management of these lands and its policing are now largely unformed. However, if the federal government should make conservative grazing management of these lands a condition of their acceptance, as would seem essential, Colorado is in a position to comply. It has an agricultural college and experiment station capable of furnishing the technical skill. By all means the management should be kept out of politics.

Merely granting these public domain lands to the states unconditionally would not improve the present situation. The chief thing is to get them under such

[1]Presented at the 30th annual meeting of the Society of American Foresters at Washington, D. C., December 29-31, 1930.

management as shall stop their deterioration.

Grazing fees should be charged whether the state or the federal government controls. These fees should pay the costs of maintaining the grazing organization, improvements, and such cultural operations as shall be advisable. It is probable that a surplus would be available to enrich the state and county treasuries.

In case the federal government controls these grazing lands, introducing range management and fair grazing fees, a percentage of either the net or the gross receipts should be passed into the state treasury for distribution to the county treasuriers as is now done with a precentage of gross receipts from the national forests.

The state or the federal government should protect the land against overgrazing. The responsible authority should determine the class of livestock to be admitted, the number per grazing unit, the grazing period, and it should enforce plans for deferred and rotational grazing where needed and look after the administration of livestock laws. Permanent range improvements, such as development of water and the building of drift fences should be undertaken.

As State Forester of Colorado, I would recommend that the federal government continue holding the public domain lands, for a whole at least, provided federal management of their use be put into effect as soon as possible. If the federal government does not feel inclined to manage them, then let the state have them. Perhaps the state would manage them. It could do so.

Colorado gets along well with federal administration of the national forests. She has confidence in the federal forest officers. The grazing management within the national forests has met with general approval. It would be safer and less confusing to let the United States Forest Service extend its jurisdiction over the 8,219,875 acres of public domain grazing land in Colorado, most of which is adjacent to the National Forests, or, at least, in the same general portion of the state.

Wyoming appears to desire to possess the unappropriated public domain within her boundaries. A candidate for nomination for Congress recently included this proposition in his platform. While he failed to be nominated there is undoubtedly in Wyoming a strong sentiment for state ownership of the public domain, including all rights below as well as above ground. The oil is below ground.

Professor A. F. Vass of the University of Wyoming in a paper read at the annual meeting of the Western Agricultural Economic Association at Logan, Utah, last summer, says he does not think the public domain in Wyoming has deteriorated during the last 35 years or that any more than normal erosion is occurring, referring in particular to the Red Desert. He doubts that range management is needed in that state, but does express a desire for the state to possess the unappropriated public domain. If management of grazing lands becomes necessary, he believes that Wyoming possesses the facilities for furnishing it.

The State Forester of South Dakota, Theodore Shoemaker, says that the

future disposal of the remaining public domain in his state is of little concern, since there is little of it. Such of it as remains is confined to rough, scattered tracts each averaging less than a section in size. The cost of administration of such areas would necessarily be high, and therefore a burden to the state. He suggests these small tracts of public domain be sold to adjacent farmers.

California's State Forester, M. B. Pratt, writing before the preliminary report of President Hoover's Committee appeared, says that he does not favor "the state handling the surface rights on the public domain, or the underground rights, for that matter." He proceeds, "It is my belief that the public domain should be handled by the Government, and I am not prepared to say at present whether it should be through the Department of Agriculture or the Department of the Interior. Much depends upon where it is finally decided to leave the United States Forest Service."

Mr. Pratt enclosed a copy of a statement by Professor Walter Mulford of the University of California in a report on "California Water Resources" an excerpt from which is as follows:

"The grass cover on the public domain also has an important bearing on erosion and water supply. The unrestricted overgrazing, which is the usual thing on the public domain is injurious alike to the livestock industry and to the public at large. The federal government is urged to take the necessary measures to put this vast area under careful management."

A member of the Arizona Land Board writes: "If the Congress should conclude to turn over to the states the forest, the national parks and monuments, together with the unappropriated and unsurveyed public domain, giving the states its entire fee without any reservations, I feel that the states would then and then only be coming into possession of their full rights." However, a prominent Arizonan in Phoenix recently informed me that the statement of the Land Board official quoted above did not represent his own views or those of many others in Arizona who are satisfied with national forest and national park conditions as they exist today.

In the Regional Office of the U. S. Forest Service in Albuquerque, New Mexico recently, Mr. John Kerr, Chief of Grazing, said that in Arizona the livestock associations prefer the public domain to remain in *status quo*. But if something is to be done, the State should come in possession of it. He said, "In Arizona the public officials do not even wish to round out the national forests with timbered areas still in the adjacent public domain."

A research forester in Tucson, Bernard Hendricks, believes that the roughest areas in the public domain in New Mexico and Arizona should be retained by the federal government in order that it might be assured of protection against further erosion.

Foresters in Albuquerque, New Mexico, hold the opinion that the state favors the transfer of the unappropriated public domain to New Mexico with no reservations as to sub-surface rights. One forester in the same city expressed his belief that "important watersheds in the public domain should

be retained by the Federal Government." Probably the Garfield Committee's tentative report covers the above provision when it advocated, according to recent newspaper account, "Flood control by the government where needed."

The State Timber Cruiser and Land Agent of the Land Department of Idaho, Mr. Ben Bush, says: "Supervision of grazing is one of the main problems that needs immediate attention, as this class of land is being overgrazed to the extent that the vegetation is pretty well gone and the grounds are becoming badly eroded." He continues, "The suggestion that surface rights of the public domain be turned over to the State, the government reserving the mineral right is far from popular here and, in fact, we are not at all anxious to secure control of something over ten million acres of public domain, even if it does include the minerals." He points out the probable conflict between the users of surface rights and sub-surface rights if they should happen to be located on and under the same area, and states that both mineral and surface rights should go together. He proceeds as follows: "We feel very strongly that the government should retain the public domain and supervise the grazing, practically the same as the Forest Service does now. In the national forests the old time controversy between the sheepmen and the cattlemen has been eliminated and the grazing areas have been very decidedly increased in value by not allowing overgrazing." He calls attention to the need for watershed protection, and the fact that rivers heading in one state flow into the adjacent state; that national control of watersheds is demanded, for fear that a state might be negligent in this matter, thus causing distress and losses in other states through which the river flows. In comment it may be said that President Hoover's committee recognizes the need for government flood control where needed, and government assistance where more than one state is involved, yet elimination of theories of federal ownership of water.

State Forester Rutledge Parker, of Montana, writes: "The remaining unappropriated forest lands in Montana under jurisdiction of the Interior Department are negligible in comparison to the acreage of lands in other classifications.

"The most accurate data available indicates that only about 200,000 acres comprise the total of the unappropriated, or public domain forest lands—or .0174 per cent of the total forested area. About 125,000 acres of this are located in a more or less continuous block, 80 per cent of which can be classed as protection forest and the remaining 20 per cent has no present value as a source of timber supply. Since about 90 per cent of all the protection forests in Montana are within the National Forest," Mr. Rutledge continues, "I can see no reason why the government should not take over such lands of the remaining 10 per cent as are adjoining or contiguous to their holdings. The drainage of all the protection areas are feeders for streams that are interstate in character, the protection of which is more a national than a state function. The increased cost to the government will be negligible since the personnel is already on the ground delegated to perform similar duties."

The remaining 75,000 acres of the public forest lands are scattered, Mr. Rutledge says, throughout the entire commercial forest belt, adjacent to private and state holdings where they could be conveniently administered by the state, since they are all situated within the boundaries of fire protective associations with the state coöperating. He believes that, should the federal government grant these forest lands to the state, Montana would do well to accept them, since in time a considerable revenue can be derived from them.

The public lands in eastern Montana are chiefly of use for grazing. Mr. Rutledge believes the proper management of these grazing lands embraces the restoration of those partly depleted by reseeding through artificial means or by closure to stock until the areas can be reseeded naturally and brought back to maximum forage production. "Since the federal government in the beginning of Montana's statehood presented it with 6,000,000 acres, most of which the state still retains, the remaining 7,000,000 acres of public domain might as well be added at the present time, since this acreage can be handled to better advantage with the present state holdings than they can be apart from them."

"If the grant is made, the best of the soil might be sold to swell the funds invested for support of the common schools, while the vast areas of such low productivity as not to warrant private ownership would comprise community ranges to be regulated, largely by local stock associations under rules for local security and for the prevention of range deterioration."

He closes with the following warning: "Should the government decide to turn over to the state the surface rights to these lands, certain definite restrictions or regulating for use should be inaugurated. Wholesale unregulated use should not be permitted for the purpose of securing income only. Conservation should be the primary aim, in order to safeguard against overgrazing and to prevent, so far as possible, excessive erosion."

Utah's Extension Forester, Mr. Geneaux, believes that his state will not ask for the unappropriated domain. He says, "The public domain, it is well known, has been ruined by uncontrolled grazing until the original vegetation, which had a high forage value, has been destroyed, or, at least so greatly diminished that a longer period must elapse before revegetation can be accomplished."

He continues: "If such a transfer were made, I believe that the better lands which are now contained in the public domain would soon be transferred to private ownership and the rest of the land would be inefficiently handled, if indeed it were subjected to any regulation at all. The history of state ownership of land is proof enough that individual states are not prepared to undertake the management of the public domain."

Mr. Geneaux says that his views have been largely guided by those of Mr. William Peterson, Utah's representative on President Hoover's committee. Fortunately this committee in its tentative report recommends that the initiative leading toward acquisition of the public domain must be at the state's request.

No state will have the land forced upon it.

In conclusion, in at least several of the public-lands states, a surprisingly small amount of public interest has been expressed in the newspapers concerning the disposal of the remaining 178,969,446 acres of public domain. This would seem to be of sufficient importance to warrant a lively discussion, in the eleven western states. It is difficult to determine a concensus of opinion even in my own state. Undoubtedly President Hoover's committee has obtained a cross section of it throughout the West. But there appear to be many different views. Both state and federal foresters in the West to a large extent seem opposed to state ownership of the public domain. An exception is made of Montana. State land boards generally, yet with exceptions, seem to favor state ownership. South Dakota, North Dakota, Washington are not much concerned, having little public domain left.

# MANAGEMENT OF SOUTHERN PINE FOR NAVAL STORES[1]

By INMAN F. ELDREDGE

*Forest Manager, Superior Pine Products Co., Fargo, Ga.*

In the second-growth longleaf and slash pine forests of the South, naval stores production is superior to saw-timber production. The production of the former requires a specialized form of management, the features of which the author describes. The multiple utilization afforded by naval stores, saw-timber, and possibly also pulpwood from the same stands, combined with cheap operation and climate that favors rapid growth, make the southern pineries seem a particularly attractive opportunity for industrial forestry.

THE GUM naval stores industry, in this country, is confined to the longleaf and slash pine forests of the South. The industry is an old one, dating back to Colonial days and is one that has always been and is now of international importance. It employs directly fifty thousand men and turns out annually products worth in round figures the sum of forty million dollars. It is an industry that will be with us always and as our knowledge of wood chemistry grows it is undoubtedly destined to play even a larger part than it has in the past. Notwithstanding the magnitude of its operations and the great expanse of area covered by it, the industry is comparatively little known to the general public outside of the South. It is carried on, in the main, by people born and bred in this line of work. From the earliest Colonial days to the present, son has followed father in the production, the financing and the marketing of the gum products of the southern pine. The "tar heel," like the sailor follows his calling somewhat set apart from the rest of the world.

The naval stores industry is of particular interest to the forester on account of its relationship to the management of the longleaf and slash pine forests of the South. The fact that this industry exists today and that it has a bright future before it makes the management of the long leaf and slash pine under sustained yield a practicable thing. No section of our country today shows a better opportunity for forestry than the naval stores belt. The coastal region of the Southeastern and Gulf states is undoubtedly destined to be the home of industrial forestry.

The old stand of virgin timber has been removed from the greater portion of the pine forests of the South. The eastern portion of the naval stores belt was operated first and abandoned for many years by the turpentiner. During the interlude of abandonment, notwithstanding brutal treatment and shameful neglect there has come back in the more favored regions heavy stands of young growth. While the area reforested by no means compares with that originally covered and while the size and quality of the timber is inferior to the original pine, nevertheless there is sufficient

[1]Presented at the 30th annual meeting of the Society of American Foresters at Washington, D. C., December 29-31, 1930.

growth already on hand of workable size to supply all of the naval stores for which we can find a market at the present time. Not only is this true but there are millions of acres now in process of reforestation that will be ready to take up the burden of production when the timber now being exploited is abandoned and cut. The extent of this reserve crop will depend almost wholly upon the success or failure of the educational campaigns against the old and still prevalent custom of burning the woods.

In the eastern part of the longleaf pine region, namely in the Carolinas, Georgia, Florida and Alabama it is likely that for years to come longleaf and slash pine forests will be managed primarily for the production of naval stores and all other uses will be secondary. In the remnants of the old stand now to be found in Louisiana, Mississippi and Texas, gum production is secondary to the production of lumber.

There is a very marked difference in the management of forests which are designated primarily for the production of naval stores as against those destined primarily to produce saw timber. The naval stores forests require different treatment from earliest infancy on. Especially is this true in the case of privately-owned forests. As I see it, naval stores forests should be managed on a short rotation, say from 40 to 60 years. The management and silviculture must be designed to produce the greatest quantity of naval stores per acre at the smallest cost in the shortest possible time and with the greatest degree of stability and all with the minimum damage to remaining wood products values. These objectives obviously require a specialized technic throughout the rotation. It will effect silviculture, management, protection, transportation facilities, and of course utilization and will bring about a grouping of industries not to be found in those forests of the same species managed primarily for saw timber. It will attract the investment of entirely different capital and require the services of foresters trained and experienced in this particular line of forest activity.

In the following remarks I shall discuss in a general way the major features of management for sustained yield naval stores production. I have in mind in this discussion large ownership rather than small holdings and of a forest section typical of the eastern territory in which the original growth of timber has practically disappeared and the forest stock consists of second-growth longleaf and slash pine ranging in age from zero to 40 years, a goodly portion of the large second growth having been already cupped during the last ten years.

The owner may elect to operate his timber himself for naval stores, to log and mill his timber when it has been operated and to carry on all other utilization processes or he may choose to manage his timber propery as a business in itself and turn over to others through lease or sale of stumpage the various utilization operations. If the owner is of the turpentine fraternity he will most likely operate for naval stores and thereafter sell stumpage to timber men. Regardless of his choice as regards utilization, the principles of management remain very much the same if he has set out to get sustained-yield

production. At this time, owing in part, no doubt, to the vicissitudes through which both the naval stores and the lumber industry are going it would seem to be the best business for the owner to make the growing of trees his objective and to derive his income from the lease of turpentine rights and the sale of stumpage. In happier times it is always possible for the owner to participate in any one or all of the utilization processes.

The first essential in the management of a property is of course a knowledge of what there is to deal with in the way of land and timber. A comprehensive survey involving the enumeration of trees by types, species and diameter classes is necessary. This information can be gathered at comparitively small cost based on a 5 per cent strip cruise. The map will be sufficiently accurate if it shows very simple topography, forest types and culture. The owner must have a knowledge of the rate at which the different diameter classes are growing and the rate at which he may expect his cut-over or barren lands to restock.

With this information at hand and with a knowledge of the methods of turpentining to be followed any forester can readily calculate the sustained yield possibility expressed in number of crops per annum for the whole tract or any part of it. In a large tract he will most likely wish to divide the area into several sustained-yield units in order to better provide for effective utilization. With naval stores as the main product the size of these areas would be such as to maintain in each a turpentine operation on the most efficient basis.

The order of utilization is, first, operation for naval stores, covering a period of from 15 to 20 years, then, operations to remove the residual wood products values. When a crop of turpentine timber has been completely worked out, the cups and gutters are removed and the area turned over to loggers who take out all of the abandoned trees in the form of poles, saw logs, ties, pulpwood and fuel. The most efficient logging operation is, of course, one in which all wood products are removed at the same time, but this is often not possible.

To justify logging in scanty stands, especially where only one or two commodities are being removed it is frequently necessary to allow abandoned turpentine timber to accumulate for some years in a locality until a sufficient acreage and stand per acre is available to attract timber removal operations. Thus, while naval stores activities may be continuous it is likely that logging operations will be periodical.

It would be ideal if the second-growth timber of which I speak had come in in even-aged bodies over large areas but this is seldom the case. It is rare that in any given section or lot of land all of the pine timber can be cupped for turpentine at the same time. Usually there are three or four distinct age classes on the same lot and frequently on the same acre so that both the cupping and the logging follows more or less a selection system. After the next twenty years, if we have fire protection no doubt we can approach what the French have in their Landes region, even-aged stands by compartments, allowering utilization on a clear-cutting basis.

It is not necessary for the turpentine operator, after he has cupped and worked one size class on a given lot of land and has moved his cups to wait until the logger has removed those trees before he can start on the next smaller size class. Frequently he will cup and work out two or more size classes before the logger finds sufficient justification to remove the abandoned timber.

A conservative system of turpentining in so far as chipping and cupping is concerned is essential in any long time operation such as is involved in a sustained yield project. Turpentine operators generally throughout the South have learned this lesson. Timber owners will no longer allow the destructive and short-lived operations that were the rule from the beginning of the industry up to a decade or two ago. It has been demonstrated time and again that timber can be worked profitably for naval stores over a much longer period of time than was formerly thought practicable and with a much lessened effect on the value of the final wood products.

It is most profitable to cup and work no timber until it has reached a diameter of ten inches outside of bark, breast high. Not more than one cup at a time should be hung and the face should be chipped not more than one-half inch deep, nor should each streak take more than one-quarter inch of new wood at the upper side of the face. Trees operated in this manner will produce at least as much gum per annum and it is entirely possible to operate thrifty second-growth trees for at least 18 years with a minimum effect on growth and quality of wood products.

The exigencies of management may dictate rapid operations at various times and places. A less conservative system may be profitably employed on timber which is to be thinned out of an overpopulated stand as well as in the case of timber that must be logged out at an earlier date than would be the case if it were held for the conservative method. The more rapid operation should take the form of working two or more faces at the same time and working wider faces.

A sustained yield turpentine operation, in theory at least, calls for approximately the same number of crops under operation each year and that these crops contain the same relative proportion of first-year, second-year, third-year and "high" faces all the time. In practice however circumstances such as the state of the naval stores market and labor shortages may and often do dictate variation from the rule. The annual budget must take into account a good deal more than a mathematical progression through the timber.

Timber worked in the conservative system described above is of real value when it is turned over to the logger. The number of trees actually killed by turpentining in thrifty second growth is so small as to be negligible. The worst that can happen is the loss of that portion of the butt covered by the turpentine faces, and under the quarter-inch chipping rule, this space in 18 years operation, spread over three faces will not exceed 6 feet above the stump. At the present value of naval stores leases this 6 feet of wood will have returned a stumpage value of $32.00 per thousand feet at the end of the 18 years with only

a minor effect on the value of the remainder of the tree.

To the forester who is handy with a pencil, and who has the requisite data at hand there are a number of ways of calculating the sustained-yield possibility of a given tract of turpentine timber. The simplest approach is to consider that you have that length of time to work out a given diameter class that it takes the next smallest diameter class to grow to the minimum size required for cupping. For example, if you have 100 crops of timber ten inches and above, and your next smallest diameter class will take ten years to reach an average diameter of ten inches you have a possibility of cupping ten crops of trees each year for ten years. If the diameter class distribution is very uneven, or is broken, a variation to offset the danger of a hiatus or a reduction in operations will be in order. Once cups are hung on the trees, you are committed to action for the next 15 or 20 years. The allocation of the annual budget to specific crops on the ground call for much ingenuity and foresight, and even then one frequently makes an error.

In choosing his crops for operation the manager must first of all choose areas that are sure of a profitable operation for the entire period. He must then be sure that the location chosen will allow the removal of the trees by the logger, also at a profit, when abandoned by the turpentiner. He must think also of the sivicultural condition of the areas under consideration. If the gap in diameter classes is too great he may perhaps want to delay operations in some particular area. Nothing very technical is involved, just a lot of common sense and the courage to attempt to visualize two distinctly different utilization operations separated from each other by a 20-year interval during which the circumstances of both industries are often changing over night.

The control, on the part of the forest manager, of the naval stores operations is neither difficult nor expensive in an organized forest. He provides specifications for cup hanging, for chipping and pulling and for removal of the cups and gutters. They must be enforced. The operator should be under bond and there should be a penalty clause in the contract. Field inspections at intervals of not less than once a month are necessary. This may be done by the fire protection force with not much additional cost. Being reasonable in little things and severe as to the essentials is the right policy.

Protection from fire is an essential in the management of a sustained yield forest of any kind. This is especially true in an intensively worked forest where we operate on a short rotation and want fully stocked stands of the thriftiest possible growth. We need the full growing capacity of the soil and climate. Protection from fire is difficult in any pine forest; it is all of that and more in a naval stores forest in the open stock-raising regions of the South, but it can be done and within a reasonable cost. The usual outfit of patrolmen, towers and fire lines, together with an untiring patience with local customs and a willingness to stay with the problem night and day brings reasonably good results.

The biggest part the forester can play is in greatly increasing the stand of trees per acre in the succeeding crops

and in shortening the interval between crops, and here he can pay for his hire many times over. A generous soil and a blessed climate requires of him only protection from fire, a little knowledge of the siviculture of longleaf and slash pine and a fair measure of common sense.

Unfortunately the silviculture of longleaf and slash pine is not well known and most of us are being forced to feel our way rather timidly. In the region of which I speak we are ready now to do a great amount of thinning in young stands of slash pine, but no two of us think alike as to how, when and where it should be done.

Operators in present stands of timber are working less than thirty cups per acre on the average. We are confident that if we can solve the problem of thinning and have reasonable success with fire protection we can provide the operator of the future with stands of better trees running from 100 to 200 cups to the acre, and we can do this within the next 15 years.

While the growing of slash and longleaf pine primarily for turpentine and rosin works in well enough with the production of lumber, poles and ties, it is with the production of pulpwood as a by-product that most of us are intrigued at present. The establishment of paper mills in larger numbers in the South will remove the last possible obstacle to successful forestry in the naval stores belt. Then we can make our thinnings pay for themselves and help bridge over the twenty years interval between seed and turpentine and, after turpentining, provide a market that will insure the profitable removal of the abandoned trees as fast as worked out.

Picture to yourselves a forest operated on a rotation of 40 years from seed to stump in which the only period without annual income is the first 15 years.

Except at such times as these, when nothing pays, the production of naval stores is a profitable operation, both to the producer and to the timber owner. Properly safe guarded, the tapping of the trees does not reduce the final yield of wood products to an unreasonable extent. It provides a steady and satisfying income to the timber owner beginning at an early age in his timber and lasting until he can sell it for removal at a profit. It takes some of the curse out of compound interest calculations and makes slash pine in the South one of the most promising mediums for the forester's use.

# REFORESTATION OF ABANDONED FARM AREAS IN NEW YORK STATE[1]

By DUNCAN G. RANKIN

*Forester, New York State Conservation Department*

New York State has embarked upon a huge plan of afforesting sub-marginal farm lands. The author describes some features of the undertaking and gives some detailed data and information on the actual planting methods and results.

THE GREATEST forward step to relieve the problem of making productive the vast acreage of abandoned farms in New York State was inaugurated by the Legislature of 1929 when it passed the so-called Hewitt Reforestation Bill. Prior to its passage, a survey of the situation had been made by a committee appointed by the 1928 Legislature and known as the Reforestation Commission. Economic surveys had also been made of various areas of abandoned or sub-marginal farm lands by the State College of Agriculture (2), all of which helped to support the prevailing idea that there are about four million acres of idle lands in the State which are non-productive for agriculture and might well be planted to trees.

For the past thirty years a reforestation program has been in progress, and forest plantations have been established throughout New York State with the result that confidence has been gained in the value of reforestation. From a small beginning in 1900, planting has increased year by year to the present annual figure of 25,000,000 trees. These trees, grown in the five State nurseries are available not only for reforesting state-owned lands but also lands owned by other public organizations and private individuals within the State. Trees are furnished free except where private enterprise is concerned, when a charge of from $2.00 to $5.00 a thousand is made. During this thirty-year period, from 1900 to 1930, a total of 212,000,000 trees have been distributed from the State nurseries, 32 per cent of which have been used for reforesting State-owned lands mainly within the Adirondack and Catskill forest preserves, and the remainder for reforesting lands owned by others. It was therefore very evident that at the present rate of planting, it would take several hundred years to reforest the vast area of idle land, and so it was that legislation providing for an enlarged program was enacted.

This legislation was passed in the form of two companion bills. One permitted the State Conservation Department to acquire non-agricultural lands suitable for reforestation outside the sixteen Adirondack and Catskill forest preserve counties, in units of not less than 500 contiguous acres. The other, intended to stimulate interest by the counties in reforestation projects of their own, authorized the payment of State money to each county carrying

[1]Presented at the 30th annual meeting of the Society of American Foresters at Washington, D. C., December 29-31, 1930.

out such projects, $5,000 being the limit of annual State aid to any one county. Each county applying for such aid is required to submit a plan of its program each year to the Conservation Department for approval. Twenty counties have taken advantage of State aid this year (1930) with appropriations aggregating $67,556, which was augmented by the State by $48,832. These counties planted 4,772,800 trees in 1930.

The Division of Lands and Forests of the State Conservation Department has reported that there are approximately one million acres of non-agricultural lands in the State suitable for reforestation which could be acquired in tracts of 500 contiguous acres or more. Its program is to acquire and reforest this area over a fifteen-year period (1929 to 1944), at a total expenditure of $20,000,000 to come from annual appropriations of such amounts as are necessary to keep pace with land acquisition and planting (1).

To start the work, the Legislature of 1929 made an appropriation of $120,000, of which $20,000 was used for additional nursery equipment. Before the end of September 1929, a total of 4,695.97 acres, comprising six areas located in four counties, had been contracted for at an average price of $3.11 per acre. Of this total, title had been approved and payment made for 1,951.57 acres and the open land on it was planted during the fall of 1929.

It can readily be seen that a program of this magnitude requires a large organization to adequately carry it out. Such an organization is gradually being built up to meet the need. The central and western portions of the State have been divided into five districts, each comprising three or more counties, and a district forester was appointed to each of these districts early this spring. A survey crew has been assigned to each district and the staff of title examiners of the State Department of Law has been increased to keep pace with the program.

Fire protection is being maintained on each area acquired, by the appointment of local firewardens, and during periods when the fire hazard warrants it, a fire patrol is employed. Also, a system of fire lines of six furrows are plowed by means of a large breaker plow drawn by a tractor along all roads running through each area and at other parts of the interior where it seems necessary. During the year 1930, 45 miles of fire lines have been so constructed at an average cost of $22.00 per mile.

Wherever white pine was planted on these areas, the usual precautionary measures were taken to prevent infection by the white pine blister rust. Ribes have been eradicated during the past season from a total area of 2,430 acres at a cost of about fifty cents per acre. This work has been supervised by an agent working under the direction of the Bureau of Forest Pest Control.

The Legislature this year appropriated $400,000 to continue the program, and by the end of September, 40 new areas located in 13 counties had been contracted for and many adjoining parcels had been added to areas acquired in 1929. This brings the total of land acquired and under contract since the start of the program in 1929 up until the end of September, 1930, to 35,672.80 acres, the average price of which is

$3.67 per acre. These areas are all composed of lands which were once farms and are in varying stages of abandonment, with its resulting variance of brush encroachment. Practically all of them are located among the rolling plateau type of topography found on the high lands between river valleys, at elevations ranging from 1500 feet to as high as 2500 feet. Soil conditions for the most part consist of loams with varying degrees of stoniness and underlying hard pan and rock which in some places come close to the surface. The ground cover of the open land is of the usual types which characterize worn out fields and pastures, with varying degrees of sod, grass and other vegetation depending on soil conditions and length of abandonment. About one-third of the land area is in woods consisting of the misshapen type of farm woodlot from which practically everything of merchantable value has been removed, leaving an overwood of deformed wolf trees with beech and maple predominating. About two-thirds of the land area can be planted to trees and no areas are being acquired which do not show a substantial acreage of plantable land. Areas acquired thus far range in size from a little over 500 acres, which is the minimum under which we are governed by law, to as high as 3,600 acres, and no areas are being acquired in localities where there is not much chance for expansion.

Since the start of the program last year, a little over 7,000,000 trees have been planted on about 5,400 acres, including planting on three areas last fall and on six areas during the spring and fall seasons of this year. Of this total of trees planted, 51 per cent were red pine, 26 per cent were Norway spruce, 20 per cent were white pine, and the remainder, or 3 per cent, were made up of white spruce, European larch, white cedar, Scotch pine and balsam fir.

Some mixed planting has been done, the different species being planted in strips of several rows rather than alternate rows, but the bulk of the plantings have been made in the form of large scale group plantations, by planting whole fields solid to one species, the species planted depending on what was considered the best adapted. One solid area of 716 acres containing 510 acres of open land was planted with white pine as an experimental area in weevil control, about half of the trees being planted by spacing 5 x 5 feet and the other half 4 x 4 feet.

Planting is accomplished usually by crews of from 16 to 20 men, or from 8 to 10 planting teams, each crew being supervised by an experienced foreman. The so-called "rope and whistle" method with large crews of from 50 to 75 men who are guided in their spacing by a rope with markers at the required planting intervals along its length, and in their rate of planting speed by blasts of a whistle, has been used to some extent on large fields on which there was little or no brush. The ordinary grub-hoe is the planting tool used, and six-foot spacing is the usual planting interval. Trees are planted almost entirely by the "slit method" with or without removal of the top-sod, depending on size of planting stock being used and existing vegetation. A good average per planting team per day of eight hours, planting by the slit method without re-

moving the top-sod, is about 2,000 trees. Where top-sod removal is necessary, it is found to cut this planting speed down about on-third. Several sizes of planting stock of different species have been used, ranging from two-year seedlings to four-year transplants (2-2 stock), and it has been found that three-year transplants, or 2-1 stock, are best suited for general planting. It is thought, however, that two- or three-year seedlings could be developed which would be suitable.

It has not been necessary to run camps to house and feed men on any of these planting jobs for there are always one or more passable roads which give access to each of these abandoned farm areas, and the men, who usually come from the surrounding communities, are able to transport themselves by automobile or other means. The type of labor is not usually the most desirable, especially at this early stage, very few of the men having had any previous experience, but as the program progresses, there will undoubtedly be developed in each district a considerable number of experienced men who will depend on this work for at least part of their livelihood.

The cost of planting 6,500,000 trees on eight areas by the grub-hoe hand-planting methods has varied from $4.17 to $7.59 per thousand, with an average of $5.91 per thousand. This variation is no doubt due to differences in planting conditions, efficiency of labor and supervision. Some areas have many brushy fields which are planted wherever the brush is not too thick, and it has been found that the planting costs run up on such areas in contrast to areas which are practically free from brush. Then, too, on some where seedling stock was being used, it was necessary to remove the top-sod in order to get the roots of this small sized stock down into the soil, and this operation is found to run the cost of planting up about one-third more than what it would cost if top-sod removal was not necessary. It might be of some interest to note that on one area which was planted last spring with four-year old white pine transplants or 2-2 stock, the planting cost was $4.59 per thousand. These were planted with grub-hoes by the slit method without removal of top-sod, and a check made this fall showed a survival thus far of over 90 per cent in spite of the dry season.

These planting cost figures are given on a per-thousand-tree basis rather than on a per-acre basis for the reason that different spacing was used in planting on some areas and per-acre costs would not give fair comparative figures. Cost figures include labor, supervision and expenses but do not include cost of trees. Crew laborers are paid $4.00 per day and foremen $5.00 per day.

A new departure in tree planting methods has recently been developed, which although less than a year old, has already proven its possibilities and will undoubtedly be of great value in carrying out this large scale reforestation program. This is in the form of a machine tree planter which was invented by Mr. H. R. Walling of the Champion Sheet Metal Company of Cortland, N. Y. This company, together with the active coöperation of the State Conservation Department in the form of advice and supplying trees for tests, has been

instrumental in developing it within the past few months from a somewhat crude contraption to a machine of improved design.

Two types of these machines have been developed, one known as the "Champion Simplex Reforesting Machine," plants a single row of trees at a time, requires two men to operate and a team of horses to pull it; the other, known as the "Champion Duplex Reforesting Machine," plants two rows of trees at a time, requires three men to operate and is tractor-drawn. The method of planting is practically the same with both types, and to simplify matters, I will try only to describe the duplex machine.

The machine is of all metal construction with heavy steel bars making up the frame work. Attached to the frame is a low platform equipped with two adjustable seats, in front of each of which is a trough in which a handy supply of trees is kept. At the rear of the platform, back of the seats, are several steel circles which act as sockets for holding pails containing supplies of trees. Rolling coulters are attached to the front end, one on each side of the machine. As the machine moves forward, the coulter cuts a clean slit in the sod or other matter in advance of the plow, which is bolted to the frame directly back of the coulter by means of a vertical shank. This plow is narrow and sharp-pointed and has a horizontal shoe at its base so that as the machine is drawn forward, this plow cuts a vertical slit in the ground with a horizontal cut at the bottom, the object of the latter being to make the ground on both sides of the vertical slit fall back tightly around the stem and roots of the tree after the plow has passed. The rear of the plow is provided with a slot, open at the top and extending downwards flush with the heel of the plow shoe. The object of this slot is to provide a place in which the planting operator may hold the tree with the roots downward while both sides of the slit are yet held open until he moves the tree backward beyond the rear of the slot, when the slit immediately closes in on the stem and roots of the tree. About a foot or more directly back of this slot are two small wheels attached to the frame diagonally so that they toe in, with an opening between them at the point where they touch the ground of about two inches. These wheels roll on each side, pressing the slit down firmly about the tree, and are adjustable for exerting varying pressure on the ground, which was found to be necessary on different types of planting sites. The rear of the machine is supported by two wheels provided with split rims which can be adjusted so that the rims of each wheel run on both sides of the slit and again press the ground down tighter around the tree.[2]

The front end of the machine is also provided with two wheels, one on each side, which do not support the front end in any way, but are set off-center and merely drag along the ground until some obstruction, such as a large rock is encountered, when they are thrown over forward and as the machine is moved ahead, they raise the front end and bring

[2]Improvements are continually being made in the design of the tree planting machines and description as given in this paper may not conform in all details for the future.

the plows practically out of the ground, thus surmounting the obstruction. Attached to the rear of the machine is a trailing wheel, with a device on it which rings a bell at six foot intervals in the movement of the machine. This bell guides the planting operators in their rate of planting speed.

The two operators or planters sit in the seats on the platform of the machine and provide themselves with a handful of trees from the troughs in front of them. As the machine moves forward, each planter rolls the trees out one by one between the thumb and fingers of one hand into the grasp of the other, by which it is held in the slot until the bell rings, giving him the signal to move it backward, when he almost immediately feels the ground tighten around the tree and he releases his grasp, and so on at regular intervals. The maximum planting speed for the Simplex machine is about 1200 trees per hour, while the maximum for the Duplex machine is about 2500 trees per hour.

Several types of tractors have been tried out with the Duplex machine and it has been found that the crawler-type tractor is the best suited. The Duplex machine is also provided with a spring type coupling so that when a pull of over a certain force is exerted, this coupling releases and so prevents breakage.

The first machine developed by the inventor was the Simplex type. It was tried out the latter part of the planting season this past spring, and 75,000 trees were planted with it at a cost of $3.36 per thousand, which figures include an item of $50.00 for transporting the machine from the factory to the job and returning it. With the Simplex machine which was purchased, 74,580 trees were planted this fall at a cost of $3.03 per thousand. This makes a total of 149,580 trees planted with the Simplex machine at a cost of $3.13 per thousand. These figures include cost of team hire, labor, supervision and expenses. The Duplex machine was developed during the summer and with the two machines of this type which were purchased, 443,885 trees were planted this fall at a cost of $2.15 per thousand, which figure includes cost of labor, supervision and tractor operation. This makes a total of 593,465 trees planted thus far by the both types of machines at an average cost of $2.40 per thousand, which is less than half the average cost of hand planting.

All sizes of planting stock of various species have been tried out with the machines and it is found that three-year-old transplants of the most species are best adapted for its use, although it will plant larger stock. A check made this fall of the 75,00 trees planted with the Simplex machine last spring, showed a survival thus far of about 80 per cent in spite of the dry reason, and which compares well with trees planted at the same time by hand planting methods. We will know more about results next spring.

These machines have been tested out on various types of planting sites and have been found to work successfully on fairly rough ground, steep slopes and even on areas with scattering brush. They will not do away entirely with the old methods of hand planting, for on all abandoned farm areas there is a con-

siderable proportion of the plantable acreage which is too stony, steep or brushy to successfully use the machines, and which will have to be hand planted.

The great reduction in planting costs by the machine method will undoubtedly prove an incentive for increasing reforesting activities throughout the country, and coming as it has at a very opportune time in New York State's program, will greatly facilitate carrying it out successfully.

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Take, for instance, the field of forestry. An analysis of the income tax returns of our industries,—not in a year of depression but in a fairly good year, in 1926 for instance, shows that the total assets of our big industrial corporations amounted to some 250 billion dollars. The net returns on these assets were about 8 billion dollars, or about 3 per cent.

Why, there is no forest in this country, except possibly the swamp forest of the northern Lake States, which is not earning through growth alone, without the effort of man, from 2½ to 3 per cent.—Raphael Zon.

# FOREST ECONOMICS OFFERS A CAREER TO FORESTERS[1]

By R. E. MARSH

*Division of Forest Economics, U. S. Forest Service*

Forestry should be guided by economic considerations. The policy-making efforts of the past two years have brought home the basic need of a solid groundwork of economic knowledge. By discussing various factors basic to forestry practice and describing the several important economic studies recently undertaken by the U. S. Forest Service, the author makes a strong case for forest economics as a distinct field for professional effort. At the same time is indicated the specialized type of training, interest and aptitude required of men engaged in this work.

WE ARE living in an age of kaleidoscopic changes characterized by the mechanization of industry; mass production; highly developed communication and transportation; complicated processes of distribution and financial control; new products, uses, and methods. Economic relationships have grown increasingly complex and the needed adjustments difficult to attain. It is inevitable that this situation should have made doubly perplexing in recent years the formulation of adequate forest policies and the profitable conduct of forest and wood-using industries, involving as they do one of the greatest of natural resources and an infinite variety of conditions and relationships.

Forestry is the science and art of managing forests in continuity for forest purposes. The application of forestry, whether on public or private lands, should be guided very largely by economic considerations. The industrial forest land owner is rightly concerned to a much larger extent than is the public owner with financial returns annually or at relatively short periods. The measures he can apply must be adapted to the economic circumstances peculiar to the individual property. Opinions differ widely as to what the economic circumstances justify or demand in the way of forestry measures, usually because of incomplete or unconvincing information as to what these circumstances actually are. There is reason to believe that in many cases more intensive forestry would be adopted with profitable results if the economic aspects were thoroughly understood. And in many other cases forestry would be facilitated by public action in recognition of certain economic requirements such, for example, as equitable forest taxation. An economic principle still difficult for the public to grasp is that liberal use of forest products is an important factor of encouragement to the development of private forestry, and in real forest conservation.

Public forest policy and the management of public forests should include recognition of the large collective economic values involved in the control of streamflow and erosion, in the use of forests for recreation and game supply,

[1]Presented at the 30th annual meeting of the Society of American Foresters at Washington, D. C., December 29-31, 1930.

and for other social benefits, as well as in the assurance of a permanent adequate supply of commercial forest products.

It will be observed that I am discussing forest economics in its broadest sense; namely, the relation of forests to human society. Certain important basic principles or conditions in this relationship in the United States have not changed in the last two decades. Ample forests are essential for the maintenance of the forest and wood-using industries, for permanently supplying the needs of the people for forest products, and for fulfilling adequately the functions of watershed protection. Recreational and other social forest requirements have greatly increased. There is ample evidence that, paradoxical as it may seem in the light of an over-producing and unprosperous lumber industry, forest depletion continues far in excess of replacement by growth. It is commonly recognized that such things as comprehensive fire protection in which the public and the private owner shall collaborate, equitable forest taxation, and public ownership of considerable portions of the nation's forest land are economically sound.

But all these are abstract principles or considerations. Their practical application to the individual enterprise and in the development of industrial and of public forest policies, regionally or nationally, involves facing a host of perplexing questions.

Consider, for example, the increasingly involved problem of land use in relation to forestry. Agricultural overproduction and a decreasing percentage of rural population are contributing to an increase in the area of potential forest land and at the same time to a decrease in the important rural market for lumber. From 1910 to 1925 in the territory east of the Mississippi, all land in farms decreased from 366 to 325, improved farm land from 218 to 189, and crops harvested from 138 to 131 millions of acres. The percentage of rural population for the country as a whole has decreased from 71.4 per cent in 1880 to 60 in 1900, and to 43.4 in 1930. Agricultural economists say there is still too much land in cultivation. Systematic conversion of submarginal farm land to forest on a large scale is being widely advocated as an important measure of agricultural relief. Instead of anticipating as we did twenty years ago a gradual invasion of forest land acreage by agriculture, we now have the prospect of an increase in the area of land adapted only to forest growth. What constructive measures are practical and economically sound for converting these submarginal agricultural lands and other available unproductive areas to forest use, keeping in mind the economic importance of the indirect benefits from forests to the public, as well as for supplying commodity products? What part should the public play in such conversion, and how should the federal, state, and local public efforts be outlined and correlated? How far can such conversion of submarginal agricultural land be economically carried as a measure of agricultural relief? What will the effect of all this be upon future stumpage values, upon the outlook for private forestry, and upon individual initiative?

Closely related is the impending

problem of the new public domain, as it has been so aptly called. This is being created largely by the reversion to the public of cut-over forest land through tax delinquency. Available information indicates that there were approximately 29,000,000 acres of tax delinquent land by 1929 in the three Lake States, Florida, Oregon, Washington and Idaho. The area appears to be increasing. It is bankrupt land which can neither pay taxes nor, without organized management, recompense the public for the accumulated obligations upon it. It is upsetting local political organization, and undermining the economic foundation of communities.

Plans for managing such lands are urgently needed. Their formulation requires a knowledge, among other things, of the probable area involved, the desirability of using this land for forest production, the correlation of various public ownerships, and the methods and aims of administration particularly in relation to local prosperity.

Is it economically desirable that some forest land be left idle? Much land is submarginal for forestry so far as the private owner is concerned. However, before deciding that it is submarginal for at least simple public forestry, we should consider not simply a comparison of production costs and stumpage values but also the far-reaching, collective economic advantages of the forest activities and industries which they could support, and the social services to which such management would contribute. This involves a whole complex of economic questions.

One could go on indefinitely with a list of forest economic uncertainties, problems, and objectives. Such a list might include, for instance, a reliable appraisal of present and future forest requirements based upon a detailed analysis of the trends as to present consumption by kinds of use, classes of material, species, and the situation as to materials which compete with wood; the real facts as to existing forest resources, current growth and depletion; the availability of foreign supplies and the effect of forest products tariffs upon forest land management and the welfare of forest industries in this country; forest taxation; forest insurance; new systems of forest credits; price relationships; the integration of forest industries; the relation of transportation to the forest resources and the distribution of forest products; the application of selective cutting; the conversion of going enterprises to a sustained yield basis; and the regulation of lumber production.

Foresters, as an organization, have had brought home the basic need of a solid groundwork of economic knowledge in connection with the policy-making efforts of the past two years.

All this is suggestive of the scope and importance of the forest economic questions urgently in need of study and to which the answers should and can be secured in large measure by foresters.

The application of the results of all forest research is dependent upon economic factors. Nevertheless, unfortunately, research in forest economics as a distinctive field has lagged far behind that in silviculture and utilization, although many investigations in the latter fields have necessarily included economic features.

The Forest Service is now making the most comprehensive research effort of any agency in this field. Without specific financial provision, a few economic studies had been conducted prior to 1926, when the comprehensive investigation of forest taxation was commenced under the authority of the Clarke-McNary Act. Much needed formal recognition and stimulus were given to research in forest economics, as well as in the other major lines, by the McSweeney-McNary Forest Research Act of May 22, 1928. This act, which is in effect a financial program of forest research, for the guidance of the Department of Agriculture and Congress, resulted from a very thorough study by the Society of American Foresters of the basic need for forest research and an outline of a national program for it. Because the Society was in this way so largely responsible for the Forest Service work in forest economics, and because of the timeliness of this subject, it will, I am sure, be appropriate to outline briefly the current program.

1. The *Forest Survey* is one of the most important and fundamental investigations ever undertaken by the Forest Service. Conceived many years ago, it was specifically urged by Colonel H. S. Graves when he was Forester, and has been repeatedly recommended since, but it requried the McSweeney Act to make it an actuality. It is designed to secure:

a. The forest volumes and areas by types and species, and the regrowth conditions on cut-over lands.

b. The rate of depletion by cutting, fire, insects, disease, and any other important causes.

c. The present rate of growth and the potential growth under the simplest forestry measures, and under more intensive management.

d. The present and prospective national needs for forest products by character and amount.

The Survey is far more than an inventory—it is designed to ascertain the relationships of these classes of information and such other facts as may be necessary in the determination of ways and means of balancing the timber budget of the United States.

There is authorized not to exceed $250,000 annually, and a total of $3,000,000. The appropriation in this, the second year of the project, is $125,000. $75,000 of this is being used in the Douglas fir region, which because of its importance locally and nationally was selected as the initial region for intensive study. Intensive work is also commencing in the bottomland hardwoods of the South. Preliminary coöperative work is under way in the Lake States and in California. It is planned next year to enlarge the regional work in the South, to commence intensive work in the Inland Empire, and to expand the coöperative assignments elsewhere. The organization plan, in general, is to concentrate most of the work in a relatively few regions until at least the inventory in these regions is completed. By 1932 it is hoped to commence delivering useful results for the Douglas fir region.

2. The *Forest Taxation* investigation has practically completed its field studies of selected sample states, counties, and townships in the Lake States, the Pacific Northwest, New England, and the South. It has made a thorough

analysis of existing forest tax laws and the results under them, and has made some investigation of European conditions. Work has commenced on the comprehensive report which will embody the basic research findings and recommendations of the Inquiry. It is probable that following this report the organization will enter a period of applied research and extension designed to facilitate the efforts at forest taxation reform in different regions, with full consideration of local conditions.

3. The *Forest Insurance* investigation initiated last year, has for its purpose to determine sound principles and practicable methods of forest insurance, and to facilitate their adoption. The study is under way in the Douglas fir region and eventually it is planned to extend the detailed consideration to other regions. So far, this has been a one-man study.

4. The investigation of the *Financial Aspects of Private Forestry Practice.* This is designed to provide authoritative information as to trends of timber values, costs of timber growing, returns from forestry, and other controlling factors, so that the facts can be presented upon which commercial forestry, under specific sets of conditions in different regions, can be soundly based. The initial effort is being made in the Southern Pine region by a 4-man staff. Sample counties were selected for intensive study in several states. For these counties detailed analyses of costs and returns and other pertinent data were made. The results are being assembled in the form of progress reports, some of which it is planned to publish. These will be part of the foundation upon which the more advanced conclusions of the study will be based. Eventually it is planned to extend this study to other forest regions.

This project was provided for by the initial appropriation of $25,000 for the preceding fiscal year under Section 10 of the McSweeney Act.

5. *A survey of the present status of private forestry and a thorough study of practical measures for speeding it up and for stopping devastation.* No one really knows just how far private forestry has gone or what can be expected of it under present policies. It is believed that a thoroughgoing appraisal of the actual situation and a critical analysis of the factors involved will lead to practicable measures which are considerably beyond the present forms of coöperation, but which fall short of drastic public regulation. Obviously this is essentially a forest policy study. The 4-man staff for this project is now being organized.

This project is financed by the increase of $25,000 for the current year under Section 10 of the McSweeney Act.

6. A series of individual studies of *land use in relation to forestry,* designed to ascertain the economic consequences of use or non-use of forest lands, to determine the proper place of forestry in economic development, and to develop constructive programs for improving land utilization and forest production. Examples are Sparhawk's study in Michigan, upon which his bulletin "*Economic Aspects of Forest Destruction in Northern Michigan*" was based, and later studies elsewhere in coöpera-

tion with the Bureau of Agricultural Economics and with local agencies.

7. *Prices of stumpage, logs, and lumber.* The purpose is to collect, compile, and analyze price statistics as a basis for showing economic trends and relationships. A large mass of data based on thousands of stumpage and log transactions have been collected. Compiled information on stumpage and log prices will be available for distribution in the near future.

8. *Forest Statistics.* This involves several projects which, partly in coöperation with the Census, cover the collection and analysis of current statistics as to the production and value of lumber, pulpwood, and other forest products, the quantities of wood subjected to preservative treatment, and of lumber consumption and production by states. There is being added to these an extensive round-up of current forest resource information for use pending the results of the Forest Survey.

The total amount involved in this program is approximately $270,000, which provides for about 45 technical men in addition to the necessary complement of administrative assistants and facilities. Well crystallized expansion plans should bring the appropriation up to $500,000 or more by 1938, which would call for a technical personnel of nearly 100 men. Salary opportunities are just as large in economics as in any other phase of Forest Service work.

Recognition of the forest economic field and work in it extend far beyond the Forest Service. Other agencies are deeply concerned with forest economic problems. Most foresters, whether in public or private employ, are in varying degree dealing with economics. There is an increasing number who could be classed as forest economists on the basis of the work they are doing. There is no clear-cut formula for making a list of such men. Secretary-managers of the lumber, pulp and paper, and similar associations, some of the consulting foresters, and foresters engaged in local land economic studies are examples of men largely engaged in the economic field. It would be practical to list from twenty-five to fifty or more prominent foresters in private employ who could readily be thus classified. The number is likely to increase.

The Forest Service in organizing its forest economics staff has encountered difficult problems in personnel. Taxation and insurance are examples of fields which require highly specialized training. There are few foresters within our reach who have also majored in economics and are suited to research. On the other hand, there are some who by experience and inclination are qualified for forest economic research. In some degree the same analogy may be drawn as to the forester's need for economic training as for engineering training. The forester needs an elementary knowledge of the engineer's tools, although he does not need to be a finished engineer. Forest economics research, however, is more deeply concerned with economic theory and principles than is the practising forester with either economics or engineering.

A forestry background is essential to the fully satisfactory consideration and solution of our forest economic prob-

lems. The personnel in forest economic research should consist mainly of foresters with some special preparation in economics. In view of the difficulty of finding the finished forester and economist in the same person, and to guard against running aground on the shoals of unsound economics, it may be necessary to supplement our personnel with a few men who are primarily economists and occasionally by expert consultants.

Our staff is being recruited from Civil Service registers, from the administrative ranks of the Forest Service, and from other foresters with Civil Service standing. Professional interest has been indicated by the large number of applicants who have responded to the Civil Service examinations for forest economists.

Forest Service experience has emphasized the need for men with better rounded-out training in both forestry and economics. There is every reason to anticipate an increasing number of attractive opportunities for highly constructive work in forest economic investigations, not only in the Forest Service but with other public and private agencies. It is to be earnestly desired that a number of able foresters will supplement their preparation for research by special graduate work in economics. Similarly there is opportunity for a limited number of men to supplement straight economic training with a few courses in forestry to give them a general forestry background with a view to assignment in forest economics research. I am told that the Forest Education Inquiry has found a strong emphasis by foresters generally upon training in economics.

These needs and opportunities merit the serious consideration of the forest schools. I understand that, broadly speaking, the amount of basic economic training included in the forest school curricula or listed as a prerequisite to graduate work in forestry has not greatly changed in 20 years. It is not within the province of this paper to discuss forestry education. I would say in passing that I believe increased emphasis should be given to the importance of the basic courses in economics and to the correlation of economics with forestry; that selected students should be encouraged to specialize in economics in connection with graduate work; and that adequate facilities to permit this should be provided. Fortunately the graduate schools are giving increased consideration to this.

In conclusion, I cannot emphasize too strongly the fundamental and controlling importance of economic factors in the progress of forestry. The apparent economic obstacles are a challenge to the profession. Foresters should take the lead in overcoming them. Appreciation and investigation by foresters of the economic problems in all their complexity should not lead to dilatory tactics or reactionary policies. A thorough understanding of the economic values at stake will emphasize the indispensability of permanently productive forests. Enough is known about the forest situation to justify more aggressive action than is now under way.

The definite and growing recognition of forest economics as a distinct field for professional effort is well deserved. Progress in clarifying forest economic

principles in the formulation of forest policy and in forestry practice will open up new economic problems and possibilities. The demand for competent personnel in this field is bound to grow.

Forest economics offers a splendid career in forestry, full of opportunities which, for constructive accomplishment, have never been surpassed in the history of the forestry movement in this country.

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Wood is the most elastic organic matter and can be moulded in a thousand different shapes and forms. Human civilization, more and more, depends upon organic matter. The pronouncement of chemists, at times bombastic, that eventually everything will be produced synthetically, overlook the fact that even for synthetic products organic matter is necessary as raw material. They may produce artificial silk, but they need the fiber of wood for that purpose. They may produce generator gas, but they need the carbon of organic matter stored by plants either in past geologic epochs or in modern times.—Raphael Zon.

# PROFESSIONAL SERVICE WITH THE STATES[1]

By C. P. WILBER

*State Forester, New Jersey*

The field of state forestry is here held up as an attractive one for properly trained men whose aptitudes and preferences are for state employ.

IN THE beginning was the federal service. This was as it should have been. It was not only fitting but fortunate that American forestry could make its start in the field where the outlook was broadest; where the experience could be widest; where the contacts could be with country-wide conditions. The contribution of this pioneer group to the profession of forestry and its work has been and still is of tremendous value.

But forestry had not long begun in the United States before other doors began to open to the forester and early, if not first, among them was the call for professional forestry in the states. These opportunities, almost without exception, in the earlier days involved administrative and educational activity, which centered primarily on the ever-present and fundamental problem of fire protection. The forester, of necessity, was compelled to face the administrative task of organizing and managing a protective organization and of mobilizing public consciousness behind this major forestry activity.

The general trend of forest-mindedness throughout the nation and the active operation of organized forestry programs in much of the country have leavened much of the lump since then. However, pioneer conditions still prevail in some states within which the forestry movement is still unorganized or still in its infancy. State service, therefore, offers a wide variety of opportunity to the forester along administrative lines. New building in virgin fields, the supervision of going forestry projects or forest properties in the older organizations and administrative direction of the programs in the states demand continual recruiting from trained men of those with ability and preference for this type of work.

As the work within the individual states has matured, in many instances over periods of a quarter century the forestry programs in the states have developed in complexity. Protection, promotion and administration still are and probably for years will continue to be the cornerstones of the forestry programs in every state, yet in the older organizations now there are few kinds of forestry activity which are not handled by the state's professional foresters.

In states where the work has evolved over a period of years we find, in addition to the demand for administrative capacity, a great diversity of openings under which the forester with natural

[1]Presented at the 30th annual meeting of the Society of American Foresters at Washington, D. C., December 29-31, 1930.

aptitude for more technical professional service is required. Whether it be in research, in reforestation, in applied silviculture, in the sphere of economics or in any other of the wide range of activities into which foresters are finding their way throughout the country, state organizations, more and more, are requiring men specially trained for specific lines of work. Along with the opening up of these lines of work, state service is demanding of the forester a galaxy of other contacts along lines closely related to forest management. The amazing awakening of people everywhere to the out-of-doors has naturally turned them to the forester, as an out-of-doors man, for leadership in the development and maintenance of the open spaces for recreation. The forest cover, so absolutely essential to such an environment and the wild land so naturally the forester's workshop, are bringing the professional forester to grips with recreation as one of the features of his program in every state.

Hand in hand with this vision of the woodlands as a playground, in addition to their economic significance, there has grown a recognition of their need to the sportsman. For wild life food and shelter and for sustained and good quality stream flow, this army of citizens now calls upon the forester for his coöperation.

Thus there is a growing list of problems coördinate with the forestry work, with which the forester must deal. Shade trees and tree surgery; Arbor Day and similar occasions with all their possibilities for understanding of the forest situation by the coming generation; park needs and programs, which can so tremendously help or hinder forestry support if wisely or unwisely led; potable water and power problems, in the solution of which the forester can and should serve both the water and his own forestry program. These, among others of the forester's ever-widening fields of service, in the main rub elbows more closely with the man in state service than elsewhere.

There are certain features of the employment in state service which are not to be duplicated in other forms of professional forestry work. It offers to the forester advantages not generally a part of commercial employment or employment with other public agencies. In state work, almost without exception, the forester is working in a field compact enough so that his contact with specific problems can be frequent, if not continuous. The state forester has better than average opportunity to see projects well toward, if not through to completion. The field is also limited enough so that he can have contact with the whole state problem and the entire program which has been set up to meet it. On the other hand the problems are diverse and numerous enough so that they offer a wide variety for observation and experience. State service presents a field in which a fixed location is in most cases possible without limiting opportunity for professional observation and contact with the variety of conditions met within the whole state. It involves to a maximum degree a possibility of cross contact with other lines of work besides that in which the man is specifically employed. In the field of forestry it is at least as free from political interference as any other public

service, despite some outstanding examples to the contrary. In states where the work has been established for any length of time it offers a permanency of employment and an establishment of policy more fixed than professional contact in many other lines of forestry work. In most states it offers, to those who are not in the superior administrative positions, a closer contact with the growth of whole local forest policy and forestry work than is available in other lines within the profession.

There is no group in the profession whose influence is as constantly and as effectively putting pressure on the private owner for the practice of forestry on private land. In fact there are few men in state work who do not have specific responsibility for such educational work in some degree. In certain areas and in some classes of ownership the consulting forester already has and should increasingly assist in the conversion of the private owner to forestry practice. But it is probably fair to say that the dominant factor in promoting private practice of forestry by the owner will be increasingly the forester in state employ.

In the field of expression, state service demands more from the competent man than most fields of work because of the general underlying promotional and educational tone of this sphere of professional activity. Both in personal interview, on the platform, and in print the forester in state employ finds continual demand for his opinions, findings and recommendations.

There is a rapidly growing army of those whose activity is in state service and the continual expansion that is going on in this branch of the profession promises to hold here an open door to the forester whose preference is for public service.

Compensation standards for public service by those professionally trained are rising, but still are notoriously lower than those for similar capacity in other lines of work. The forester whose life work lies in state service shares with the great host of professional men in public service of every sort the practical certainty of lower financial returns to himself, than those offered in private employment. On the other hand state service offers unusual opportunity for professional growth and demands in the main a high type of professional interest and ability. As such it stands out among the forestry opportunities as one of the extremely attractive and worthwhile openings toward which the man in this profession can well look for a professional career.

# PROVIDING FOR RECREATION IN FOREST MANAGEMENT[1]

By HENRY R. FRANCIS[2]

*N. Y. State College of Forestry*

The author quotes expressions of a number of foresters on the problems introduced into forest management by the phenomenal growth of recreational requirements.

DURING THE DECADE just coming to a close the recreation uses of forests have assumed overwhelming proportions. With such an extensive forest activity the necessity to provide adequately for this social use is pressing hard upon us. The worthwhileness of devoting consideration to provision for this activity is apparent when we discover that in many instances the human benefits accruing are vastly superior to the timber value of forest areas. In order to meet the problem squarely, foresters are recognizing its importance and are groping with it. The solution of this problem is of too great significance in the professional practice of forestry to treat it as a side issue to receive attention after the regular day's work is over or when that problem has grown into an emergency situation like a devastating forest fire.

In order to state the case as clearly as possible we might cite some excerpts from questionnaire returns recently received on this subject from foresters. These indicate that in the management of private forests, 4 per cent of the foresters stated their practice as having to treat recreation uses as a dominant feature, 36 per cent as a coördinated phase and 60 per cent as a subordinated utility. When we pass to the management of public forests we find that 12 per cent of the foresters are finding recreation as a dominate feature, 67 per cent as a coordinated and 20 per cent as a subordinated utility.

The reaction which came in from these foresters show 61 per cent of them very interested in this use when dealing with private forests with 88 per cent of them likewise concerned when managing public forests.

The main objective to be secured in handling this resource was commercial gain with 35 per cent of foresters managing private forests while for those on public forests 83 per cent were striving to render a public service primarily.

Having considered these generalities, it is interesting now to witness some of the trends which foresters observe as they practice their profession. In the South the leasing of hunting privileges on private forest holdings is developing so as to secure financial revenues.

In the lake region the trend in recreational development is on the increase. The public expects more than formerly in recreational facilities. The belief is that free public camp grounds will soon be replaced by better facilities for which a fee will be paid directly by the user.

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[2]Acknowledgment is due the many contributors for the excellent material sent, in answer to my questionnaire.

Also, in this region it seems plain that forest production is a phase of land utilization which to succeed must be closely worked out on adaptable areas with fish and game production and other remunerative recreational uses, which serve as a necessary year to year revenue.

Contrasting with these views where recreation is or may be commercialized we have such expressions from foresters as these: One forester writes, "Under *any* ownership or management, either commercial or recreational exploitation may be a social damage. In fact, it usually is. . . . . As to revenue, it is pernicious to attempt to place forest recreation on a monetary basis. In its proper place it has inestimable value, but as soon as commercialized and denied its intangible character, its real worth disappears."

Another forester connected with national forest administration during many years writes, "There is no charge, as you know, for the general use of the national forests for recreational purposes. The only charge . . . . is the special-use fee charged for hotels, resorts, summer camps, summer homes, etc. . . . . it is safe to approximate $250,000 relating directly or indirectly to recreational uses. . . . If the policy were adopted of charging a small admission fee to the national forests, as is done in many state parks and forests, the revenue would greatly exceed these figures but . . . . the return from the recreational use of the forests preferably should be derived through better social conditions and understanding and support of forestry as a public movement rather than in a monetary way."

Another forester writes, "It isn't 'recreation' which you sell—it is background and it can only be turned into cash to a limited extent —witness the national parks and the vast wild areas of the national forests".

Then we find an expression calling for proper balancing of recreation with other phases of forestry like this one, "I am interested, as any practical forester must be, whatever his viewpoint. It seems to me to be, like most forest problems, quite local in application . . . . nothing is more important than to prevent application of blanket rules. . . . I think the primary responsibility of forest administrators has been made unnecessarily difficult, without compensating benefit to the public, by overstressing recreational purposes without due consideration of the increased protection problem. Vast areas for which adequate protection facilities cannot be provided have been partially opened by transportation facilities and, by recreation suggestion that would not have so permeated the public mind unaided, filled with visitors not correspondingly trained to enjoy the forests safely. It is much like actual effort to herd an unappreciative, ill-disciplined and inconsiderate mob of hoodlums into a museum or art-gallery with too few attendants. It may be said that too many undeserving people enjoy recreational use of such forests anyway, disregarding private or public interest in their preservation, without our foresters promoting use without responsibility".

Passing from these typical expressions of policy, we encounter many indications of the character and extent of the problem with which foresters are being faced. Some of these read as fol-

lows: "I am inclinded to think that the public benefits derived from the recreational use of the ———— Forest probably exceed the gross economic benefits derived from all other present and potential uses. It is part of the Forester's job and I only wish I felt competent to handle it."

Another forester writes, "There is danger that in certain areas, recreation may build up so much sentimental interest in trees as to prevent legitimate development of forestry management on adjacent lands. I believe you will find this is happening in some national forests areas in California, Oregon and Washington. But I believe this need not occur if it is foreseen by the foresters in charge and met by educational means.

"The use of the Adirondack Preserve for recreation and health must yield as a result of the forests there at least $50,000,000 annual revenue to state and private enterprise. Perhaps it is several times this amount. How much would the Preserve yield on a strictly forest crop basis, without recreation? How much would the recreational value of the Preserve be if the forests were ruthlessly exploited and burned as has been done in similar areas in the Lake States!"

This pertinent suggestion was sent in by a forester of mature judgment and with wide observation of forest recreational activities, "The public generally is attaching a largely increasing value to the social service of the forests. Namely, inspirational and recreational, which in many sections now promise to transcend their value for the production of timber as a commodity."

A forester who has had a long and successful experience in New England writes, "Our experience in the White Mountains has demonstrated that recreational use on an extensive scale is perfectly compatible with intensive forest utilization, when the best silvicultural growth and not immediate commercial gain is the objective."

A forester from Colorado writes, "As time goes by the recreational use and value of forests will likely proceed faster than the economic values for wood production will increase."

Another New Englander says, "It is plain that the idea of recreational use in the broadest sense has been in the Northeast of equal and oftener of greater potency than commercial utility as a general incentive to forest management."

Some idea of the volume of work entailed in the Northwestern Regional office of the Forest Service in meeting the planning for recreation uses can be gained from the following rough estimate:

Prepared 101 intensive unit plans, total 55,000 acres.

Prepared 19 plans for national forests, which are really indices of recreational unit plans, and activities for each of the forests.

Prepared 9 primitive area reports for North Pacific forests, of which 3 are definitely approved and set aside by the Forester at Washington.

Have surveyed about 2300 summer home areas.

Have selected 615 public camp and picnic areas, of which about 70 per cent are developed or partly developed.

Have developed 35 resort areas and
24 health camp organization areas.

From the foregoing it is evident that recreational uses of both private and public forest areas is offering to the forester an opportunity to be of large benefit to humanity. This contribution must be made as a part of the duties of the profession. It looms large with the characteristics which social welfare work always holds. The technique for rendering the service has yet to be formulated. One of the beacons which beckons the spirit of the missionary is that one which shines radiantly from the recreational phase. Who is going to pave the way for a full measure of the contribution to human welfare which this phase of forestry is capable of rendering?

# THE WATER USER'S POINT OF VIEW AS TO THE PUBLIC LAND POLICIES OF THE UNITED STATES[1]

By WALTER MULFORD[2]

*Professor of Forestry, University of California*

In some regions the use of water is straining the adequacy of the supply. In these regions there is some feeling that hill lands should be managed only for the conservation of water as the crop of paramount value. The author tells in dramatic style the relation of water to life and dwells on increasing its supply though without touching on the possibility of more prudent use. The article demonstrates the need for a broader conception of forestry, a more logical balance between its departments, and for more basic information as to the influences of the forest before definite and large scale changes are made in present practices and policies.

"I SHALL NOT be able to keep my lecture appointment with your class. A meeting of ranchers has been called at Oakdale, to ask why the United States Forest Service should not discontinue the cutting of timber from the Stanislaus National Forest. I must be on hand." Such was the tenor of a message received a few weeks ago from a member of the San Francisco office of the United States Forest Service.

Oakdale is in the San Joaquin Valley of California, in a locality intensively developed through irrigation. The Forest Service had advertised a small amount of stumpage, to be cut from the mountain slopes bordering the valley. Are we to have water, or timber? Such was the question raised by these thoroughly responsible men.

The result of the meeting was a satisfactory defense of the local forest policy, which apparently settled the question for the present with that particular group. But there are deep-seated interrogation points in the minds of western water users. The Oakdale meeting was not the first of its kind, nor is it likely to be the last. Two years ago a group of sincere agricultural leaders in another locality proposed to go to the state legislature to work for a law which would permanently prohibit all logging in California. If this had come to pass, the Sierra Nevada and the entire redwood region would now be locked up as securely as are the state forests of the Adirondacks. There are many—water users, nature lovers, recreationists—who would rejoice to see a no-lumbering-in California policy adopted by the federal and state governments. The experience of New York State in the attempts to remove the constitutional ban against Adirondack logging may well give us pause as to what might happen in regions where water means life, if a rapidly-mounting public feeling is not wisely guided.

There are questions which have not been convincingly answered. Competent solution of the difficulties may pro-

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[2]The author gratefully acknowledges the use of important data furnished by Messrs. George H. Cecil, Francis Cuttle, H. S. Gilman and W. C. Lowdermilk.

foundly affect the public land policies of the United States on the National Forests, the National Parks, the Indian Reservations and the unallocated public domain.

In recent years glib phrases concerning the high place of water in the forester's program have come easily from our lips. It may be that we are actually water-wise, with the essential nature of the relation of water to other forest products clearly a part of our working consciousness. In any case, it will do no harm for us to recall to our minds the general situation. In this review, I shall speak as water user rather than forester, a water user who has learned something of the forester's technique.

We are the water users in those sections of the United States in which water, ample in quantity, and pure, is relatively difficult to get and therefore a matter of prime concern. We live at power plants, by irrigation ditches, in apartment houses. We are manufacturers, merchants, farmers, factory workers, school children, clerks.

The East has had drought this summer, distressing because of unusualness. This year many Americans have learned for the first time that too little water, as well as too much, can bring ruin. In most of the West, there is drought every year. The uncertainty is as to its severity. Always water is a prime factor in our economic life.

We employ great engineering works to conserve and distribute the surface run-off from our streams. This supply being insufficient, we utilize both artesian wells and high-powered pumps to draw on subterranean supplies. To help in maintaining the underground reservoirs, we spread surface waters over percolating basins. We are bringing a Colorado River into our homes. We are seriously considering reclaiming sewage water for irrigation.

And the net result? In many localities we are using water more rapidly than new supplies arrive. Reserve waters, like oil and coal, have been stored underground for us through the ages. There could well be a pumping budget for water, as well as a felling budget for timber, limited by sustained yield. Even for our present population, serious inroads into the reserve are being made in many places. We have seen the water levels in many of our wells go down and down, not infrequently to a depth of hundreds of feet, until pumping costs frequently exceed crop profits, even with the cheapest of gasoline. In some localities near the coast, salt sea water is working its way into these lowered levels, ruining them permanently. In other sections we have seen areas of some of our most productive lands converted to alkali desert, in part because sweet waters from the mountains were inadequate, forcing us to resort to other and dangerous sources of supply.

We have been harmed by unwise policies on public and private lands. We have done harm too. We have seen swift, swirling mountain streams in which a man, misstepping, would quickly lose his life, converted into snake-like lines of bare rock, ugly scars in the countryside. This is partly due to lower summer stream-levels following lumbering and fire, and partly because the remaining water has been diverted from natural channels in the attempt to make up shortages elsewhere.

Yes, we share in the guilt. Up yonder on the hillsides above the dry stream bed are our flume and our ditch. Through them we light homes, turn machinery, make cities possible, provide food and clothing.

We have seen some of the most beautiful of our mountain canyons desecrated and scarred with engineering works. This too is our doing. Artificial lakes have replaced mountain meadows. However, properly handled, the beauty about these new lakes may often come to be as fine as the original wildness.

Despite all our resourcefulness and all our desecration, the water supply in most of the West will remain utterly inadequate for what might otherwise be the development of both town and country, unless climate changes. Furthermore, there is no substitute for water. We have heard that some of you foresters fear that substitutes may make serious inroads on your business of raising wood. A groundless fear it would seem to us, but certainly in producing water you will have most enthusiastic customers and no competition. The competition will be among the customers.

The stern fact is that in many of our states water is the controlling factor limiting the ultimate development of the commonwealth. Therefore, it is imperative that every available means of stabilizing water conditions be utilized to the utmost.

Such is the general situation. Now what do we require of the federal government in its public land policies? That they be rigorously adjusted to produce optimum water conditions. By what means? That is for you to determine, you foresters who are our chief experts in the management of wild lands to produce maximum values. We are under the impression that thus far most of the leadership in forcing water on your attention has come from the water users themselves. Possibly you have overlooked an opportunity. In any event, we think that at this point you should take up the full burden.

Perhaps some of the things which have occurred to us as laymen may be of some value to you in your more expert planning. At least we would like to have you give them careful consideration as possibilities.

It is essential that you foresters clarify your thinking and make sure of your ground in the field of forest influences. The reliability of the existing, often contradictory data should be investigated, and the authentic facts organized and correlated. Then by greatly enlarged researches the gaps in knowledge should be gradually closed, if indeed we can speak of gaps in a structure which appears to be as yet largely conjecture with only a modicum of proven truth. Meanwhile, will you not be careful to make only such claims as you can reasonably well prove? Else you do yourselves and us great injury. All too frequently your statements conflict with those of engineers, soils experts, meteorologists and geologists, and it does not appear that you are prepared to prove your contentions in all instances. You do not always agree even among yourselves. Small wonder that we are sometimes at a loss to know whom to follow—that we are sadly confused as to the exact truth of the relation between the type of soil cover and the water supply available to us. Some of us hold

meetings to ask that no timber be cut even to build our homes, in order to take no chances either with a possible effect on rainfall or with disturbing the run-off. Others among us have urged that all the forests should be removed from the entire range of the Sierra Nevada in order that the water, undiminished in volume by the forest's own use of it, might escape more freely down the mountain sides, water and fertile silt to be distributed by great engineering works. Some of us band together to ask that all the brush lands be regularly burned over because, forsooth, it is said that chaparral transpires more water than it saves. Others hold equally enthusiastic meetings to demand that all brush fires shall cease. And in every case it is for water, water, water.

You have a great forest products laboratory up in that land where they have so much water to spare that they scatter some of it around in thousands of natural reservoirs. Actually surface reservoirs, not underground. Lakes, we have heard that they call these places. At that laboratory you are learning to reduce the waste in wood use. Also, you are finding new uses for wood so that we may use up our forests more rapidly. We do not oppose this, because we know that in the long run all of this means more intensive forestry and therefore better watershed protection, while at the same time it is helping one of the nation's greatest industries—an industry providing us all with so many articles which we would not do without.

But we are emphatically in the mood to demand equally great attention to a research need which is at least as imperative as in forest products. It is time to develop a strong research organization in the field of forest influences altogether comparable with the splendid institution working with wood in Wisconsin.

Here are just a few samples of the things we want to know definitely: do chaparral and brush use more water than they save; what kind of brush cover is most effective in water conservation and erosion control, on areas which it is not feasible to afforest at present; what type of forest management gives the best watershed conditions on the true forest lands? We should know these things as well as how to make better rayon and cheaper wood alcohol.

Yes, we would like to go even further and know whether or not we can bring rain by planting forests, if it is possible to determine this. If forests bring rain because they transpire much moisture, then there are those among us who would remove the forests and the chaparral so as to keep the water in the home land. Surely, they say, it is of more value to the nation to use this water where it can be employed to great advantage, rather than to increase by one or two inches the average rainfall on the hopelessly parched deserts over which our rain-bearing winds pass after leaving our mountains. Erosion, uncontrolled floods, a desolation of mountains not to be tolerated by a beauty-loving automobile public—these are some of the replies you fairly tumble over one another in your eagerness to give back to us. Yes, to be sure, and only a few of us are at present favorable to such drastic measures. But there are a few, the number of whom seems to be increasing somewhat, who claim that flood

waters could be controlled, erosion reduced to a minimum of injury and perhaps even made beneficial by spreading of fertile mountain soil on tillable valleys, and the real needs of mountain-loving folk met by leaving only a small percentage of the forest cover. We need facts!

Our Madison laboratory for the study of forest influences would not be highly concentrated at one place, but would necessarily have investigations under way over a wide range of territory. We dream of it as a great forest influences institute, supported either by public appropriation or by private endowment. The provision for such an institute on a noble scale might well appeal to a private benefactor as being a project requiring research of the most fundamental nature and the application of truth to practical affairs involving the very life of the commonwealth.

When the much-needed body of knowledge is available, public land policies in relation to water can be more wisely formulated. Meanwhile, in all doubtful cases, it is a sound principle to err on the side of conservatism, a type of conservatism which shall include vigorous action. Subject to revision as further facts develop, we favor these policies: on the timberlands of the national forests and the Indian reservations, the final inauguration of real fire protection through greatly increased financial support for prevention rather than suppression, management plans based primarily on water production in regions where water is the greatest forest value, a conservative timber sales policy and as rapid as possible a development of intensive silviculture; on the national parks, a continuation of the present policy of maintenance of a protective cover, with increased fire prevention; on the brush and chaparral lands in federal ownership, an uncompromising policy of maximum fire protection until and unless it shall be proven that water conditions are improved by removing the cover, and world-wide exploration for possible cover plants for our arid and semi-arid mountains; on the grazing lands of the unallocated public domain, immediate organization of an effective range management administration without interference with legitimate mining.

The public domain is suffering from uncontrolled over-grazing. Administration is needed to check the ruinous erosion now taking place, to afford in some localities a certain measure of improvement in water supply, and to stabilize the grazing industry. It is the considered and emphatic judgment of the water users of California—on this one point I venture to speak for no other state—that the public domain should remain in federal ownership rather than to be turned over to the states; and, further, that it should be transferred to the U. S. Department of Agriculture for administration by the Forest Service. This implies no distrust in the Department of the Interior, a Department which, despite some mishaps, is still heir to the fine conservation traditions of Carl Schurz, Garfield and Fisher. But range management is crop production. Furthermore, the Forest Service has a generation of hard-earned experience in grazing administration.

We believe that the forest in its relation to water is a public utility. For

our purposes, government ownership of key water areas appears preferable to an elaborate system of governmental control of private property. We ask for wholesale extension of ownership of timberlands and chaparral lands by federal, state or local governments, on areas on which water is the primary concern and on which the measures necessary to insure the best water conditions would necessitate financial injustice to private owners. Bond issues for procuring such areas are as thoroughly justified as for the construction of interoceanic canals.

We ask that water be given a definite place in the federal survey of forest resources.

Some of us look forward hopefully to the possibility of having in our federal government a Department of Forests and Waters headed by a cabinet officer, as is the case in certain of our sister nations which have learned wisdom by long experience. We would think that a president and a congress who will establish such a department, and will provide it with full sinews of war, in finances and in powers, will write an enduring chapter of American history. But whatever may prove to be the name and relative position of the government office, let us not delay too long in essential action out in the great open spaces.

Leaving now these details, let us turn our attention to a broader aspect of the situation. The classical forestry of the world, that of central Europe, has evolved through the centuries in a region with ample rainfall and for the most part with no imperative need even for taking care of surplus waters. On a few areas protection from damage caused by excessive run-off and erosion has dominated the forest policy and here, notably in the Alps, we have another type of forestry which has become classic.

The eastern United States is blessed with ample rainfall and therefore can follow, with appropriate modifications, the standard forestry of the Old World. In the Appalachians and elsewhere in the East, as in the Alps, we have the need for control of surplus mountain waters. But we water users of the West are certain that upon foresters devolves the responsibility for vigorously developing two other types of forestry: that for regions where there is ample rainfall at the sources of streams which furnish water to neighboring areas with deficient rainfall, as in extensive mountainous sections of central Asia; and that for localities in which rainfall is seriously deficient on the wild lands as well as on the farms, as in large Mediterranean areas. In the western United States, both types are needed.

A few illustrations may be useful. You have forest management plans based on wood, forage and recreation values. You will need water management plans. You have yield tables for wood based on age and site quality. Perhaps some day we shall have yield tables for water based on such factors as cover type, silvicultural system and run-off conditions. You have foresters who are logging engineers. You will need men who are forest influences engineers, not for the work better done by civil engineers, but as experts in the relation of cover to water. You will need in the Forest Service a Branch of Waters as well as one of Range Management. For the semi-arid mountains we should look far and wide for cover plants. The

ideal plant cover would be one with maximum ease of establishment and maintenance, minimum fire hazard, maximum effectiveness in retarding surface run-off and erosion, and minimum transpiration. In a semi-arid climate we are not primarily interested in the argument that the plant cover increases rainfall by sending more moisture into the air. The great sources of rainfall are not on such areas. And we prefer a bird in the hand to one in the bush—one drop of water in the soil to be kept there until used in some productive capacity, rather than one drop in the air in the form of water vapor. Once used by us, we are glad to have the drop go back into the air to be used again by somebody, sometime, somewhere. The usual type of forestry requires the temporary removal of trees by logging, so that we may build homes. A specialized forestry may prove to require the permament removal of trees along streams in canyon bottoms, in order to increase the sustained yield of water in our homes.

The foresters of New England and the Lake States will have intensive forestry because of great markets close at hand. The foresters of the Southland will have it because of wonderful growing conditions. It is reasonable to expect that the foresters of portions of the West will have intensive forestry because of a high soil expectation value based on water yields. We pay well for water. Those of us who live in Los Angeles have paid $1125 per miner's inch of water—a constant flow of nine gallons per minute. In other localities values are considered to be as high as $1500 per miner's inch. The result is that many areas of forest and of apparently worthless chaparral could well be given a capitalized value of not less than $250 per acre for the water crop alone. This should mean intensive forestry. And when once we have it, it is probable that the water users will see clearly that on most areas there need be no query, "Wood or water"? There will be wood and water. We may find that intensively-managed second-growth forests will produce more water as well as more wood than the magnificent but irregular virgin stands. The matter is so vital to us that we shall not be satisfied with your policies until we have facts rather than suppositions.

In the development of these two specialized types of forestry the United States has the opportunity, or rather the privilege, of world leadership. The reclamation of dangerously denuded forest areas, notably in the Landes district of France and in the Alps, is justly famous. But these great works would fade into relative insignificance as compared with the establishment of successful policies, based on undoubted facts and put into operation in adequate measure, having to do with the full utilization of plant cover as a conservator of water. Once solved in reasonable degree, not only would one of the greatest contributions have been made to a sustained yield of human living in much of our own western country, but also the way would have been pointed for many nations of the earth who are struggling against great odds as regards water supply and erosion problems, and who have not the resources with which we are blessed to help them in finding the way out. It is an undertaking rich in possibilities for world-wide human betterment. You, the foresters of America, must not be found wanting.

# FORESTRY IN HAWAII FOR WATER CONSERVATION

By C. S. JUDD

*Territorial Forester for Hawaii*

Hawaii practises forestry to increase water resources rather than to add to wood supplies, and one quarter of the land surface is managed for such purpose. Since the water comes mainly from forest areas, its quantity and timeliness are vitally affected by the character of the forest. The relation between water resources and forest cover in Hawaii is particularly intimate and delicate and the natural balance must be carefully maintained to prevent its disturbance. The author describes his problems and his organization for managing the protection forests.

WITH THE recent increase in the acreage of forest reserves in the Territory of Hawaii up to over one million acres, it may be of interest to the rest of the forestry world to know what is being done in the way of practicing forestry for water conservation in this group of Pacific Ocean islands.

The first forest reserve in Hawaii was set aside by proclamation of the Governor on November 10, 1904, on the recommendation of Ralph S. Hosmer, then Superintendent of Forestry. During the 26 years since then the work of examination, survey, report and dedication has progressed until today on the five largest islands there are 63 forest reserves varying in size from 10 to 122,782 acres with a total area of 1,021,314 acres of which 65 per cent is owned by the territorial government. This amounts to almost exactly 25 per cent of the total land area of the territory and is considered none too large to assure the growing population of a continuous and sufficient water supply. This compares favorably with other islands, with Porto Rico for example which has only 2 per cent of its total area devoted to forest purposes. Of the 35 per cent in private ownership, 21,288 acres have, under the law, been turned over to the care and control of the territory for varying periods of time.

There is probably no part of the United States where in as small an area there is as great a diversity in the quantity of water and its availability. The heaviest average rainfall in the world is claimed to be on the summit of the island of Kauai at 5,075 feet above sea level. This averages 476 inches annually while less than 15 miles to leeward of this a station near the coast records only 22 inches annually. On the windward or rainy side of the island of Hawaii the rainfall on the cane fields is great enough to raise sugar without irrigation and here the surplus water is used for fluming the cane to the mills. On other parts of Hawaii and on the other islands the sugar cane fields are irrigated and the development of water supplies for this purpose is a matter of great importance. All sources of water have been utilized and these include streams, springs, reservoirs to store flood waters, tunnels into the mountainsides to intercept ground

waters, tunnels, ditches and pipes to conduct water from the rainy windward side of the islands to the sunny leeward side, flowing wells and pumped wells. To conserve the water once it has been developed, ditches are often lined with stone or concrete to prevent seepage. Over nineteen million dollars have been invested in irrigation works alone and one water tunnel through the mountains on Oahu cost $2,500,000. Some of the irrigated plantations use up to 120 million gallons of water per day, which is more than twice the water consumption of a city like San Francisco. Nearly $175,000,000 is invested in the sugar business of Hawaii in which 49,000 people, or about one-sixth of the entire population of the territory, are directly employed. The 1930 crop of sugar amounted to 924,463 tons and was produced from sugar cane harvested from about 130,000 acres. The raising of sugar cane is done here on a large and efficient scale and since over half of the sugar is raised on irrigated areas it is needless to emphasize the favorable public opinion on all matters pertaining to a permanent water supply.

Since the water comes mainly from forest areas and its quantity and time of occurrence are vitally affected by the character of the forest, the primary reason for practicing forestry in Hawaii is not for the production of wood supplies but for this valuable liquid commodity. Building materials are obtained from the Pacific Coast of the United States in the form of Douglas fir and redwood lumber which is shipped down in schooners and sold at reasonable prices. Small quantities of the native wood *Acacia koa* are taken from lands which are being cleared for pasture and are used for the manufacture of furniture and musical instruments and an occasional shipment of koa logs is made to Indiana for veneer stock for radio cabinets and furniture. The curly grained koa wood is especially prized. The ohia wood is also converted into an excellent and durable flooring in small quantities. Other native trees are merely of botanical interest and exist in small sizes too scattered and too rare to be of commercial value. Some of them are dying out and will soon be lost forever to the botanical world. Plantations of eucalyptus have been established in many parts of the islands and are cut occasionally for posts, poles, car stakes and fuel. The chief supply of fuel comes from the algaroba or mesquite tree which now grows wild in the arid regions and has covered over 100,000 acres since its introduction 102 years ago.

The chief value of the Hawaiian forests lies in the water which they conserve and forestry is practiced here for the purpose, as specified in the law, of "protecting and developing the springs, streams and sources of water supply, so as to increase and make such water supply available for use." There is probably no part of the United States where the relations between available waters and forest cover are more intimate and more delicate. The natural balance is easily disturbed and changes by man, too slight to be noticed by ordinary observation, have produced disastrous results.

Where available water supplies are

so limited and where water is valued so highly there is good reason for devoting one quarter of the total land surface to forest purposes for water conservation. In the practical work of carrying out this purpose the object sought is to put the forest into the best possible condition for the conservation of water. The native forest must be kept intact if it is to be retained in a healthy state. The shallow-rooted trees depend upon the undergrowth of bushes and ferns for favorable moisture conditions. Cattle, goats and other stock eating the underbrush produce a condition which is inimical to the health of the forest trees. With weakened vitality, the trees quickly succumb to the attacks of insects and disease which are impotent when the forest is not opened up or disturbed. The area of the native forest has been greatly lessened in the past by stock grazing.

The practical work of forestry, therefore, consists in clothing the watersheds with the best possible association of trees, plants, and other vegetative cover for the holding back of excessive runoff. This is being accomplished by the demarcation of mountainous areas to be devoted to this purpose as forest reserves, by getting rid of the wild stock still at large in the forests, by fencing forest reserve boundaries which are exposed to inroads of tame cattle, and by planting up the areas which are in need of reforestation.

Since the inception of forest work in Hawaii a quarter of a century ago, the force to carry on the field operations has gradually been built up with the appropriations made by a favorably-inclined legislature until now in addition to the Territorial Forester there are four trained assistant foresters, one for each of the four main islands, eighteen forest rangers who are local men trained to the work, 29 workers in the four tree nurseries and 35 tree planters, a total working force of 87 men. The total appropriation for the present biennium is $261,790.00.

Each ranger is equipped with a .30-30 Winchester carbine and he is supposed to know how to use it as effectively as he drives a fence staple or plants a tree. It is his duty to kill wild cattle, goats, pigs and sheep on all government lands in the forest reserves whenever he comes across them. Assistance is rendered to land owners adjacent to forest reserves in driving and rounding up wild goats which devastate grazing lands and destroy tree seedlings. Our campaigns against destructive wild live stock during the past three calendar years have resulted in getting rid of at least 22,364 wild goats, 6,483 sheep, 4,887 pigs, 495 cattle, 27 donkeys, and 8 horses or a total of 34,264 wild animals in and near forest reserves. These figures, however, are far from complete.

Because of its greater durability, redwood from California is used almost exclusively in the form of split posts for the fences along the forest reserve boundaries which are exposed to tame grazing stock. The most weather-proof wire, No. 6 gage copper-bearing, galvanized wire, is used and so spaced that a cow cannot get her horns between the lower wires. Five wires are used and the posts are spaced 24 feet apart with two Douglas fir spreaders between posts.

Where local posts are used they are spaced eight feet apart. During the past 20 years 172 miles of new fences have been constructed on forest reserve boundaries and all existing fences have been kept in stockproof condition by frequent inspections and repairs.

As stated above, the original native forest has been sadly depleted by the inroads of stock previous to the adoption of any protective measure. This has left many areas, within forest reserves and along the border of the remaining forests, which are in need of regeneration. It is estimated that approximately 45,000 acres remain to be planted up although some of this will be covered in by natural reproduction from wind-borne and bird-scattered seeds. During the past 14 years, 1,281,562 trees have been planted out in forest reserves. This does not appear to be an extraordinarily large amount but it should be borne in mind that every one of these trees was set out with a ball of earth around the roots. The bare root system method is not practicable in Hawaii because of the scorching sun and drying winds. The ball planting method, moreover, insures almost 100 per cent success. The 35 tree planters are now setting out trees at the average rate of 33,000 trees per month on 15 different planting sites located on four different islands. The areas in need of reforestation vary greatly in many respects—in elevation, from sea level to 8,000 feet; in rainfall, from 20 inches to 300 inches per year; in soil, from stiff clays to rich loam. For these reasons, it is necessary to use a great many different species for the various planting sites. In addition to this, we are trying out many species in the attempt to determine those which are best suited to the particular sites. It is not remarkable, therefore, that among the 298,651 trees planted in forest reserves during the calendar year 1929, as many as 145 different species of trees were employed. These come from all parts of the tropical world and those from Australia and India are found to be particularly adaptable to our climate. Very few of the indigenous trees are used, mainly because they are too slow of growth and preference is given to introduced trees which reproduce readily either by their seeds being carried on the wind or spread by birds. The following species headed the list in last year's planting in the numerical order given: White ash (*Fraxinus americana*), Paperbark (*Melaleuca leucadendron*), Silk oak (*Grevillea robusta*), Swamp oak (*Casuarina glauca*), Redwood (*Sequoia sempervirens*), the native koa (*Acacia koa*), Cypress (*Taxodium mucronatum*), Jalna (*Terminalia myriocarpa*), Highland ironwood (*Casuarina quadrivalvis*) and Logwood (*Haematoxylon campechianum*).

The young seedlings are raised in flats and pricked off into boxes or rejected cans which are obtainable by the thousands free of charge at the pineapple canneries. All soil used in the flats and cans is first sterilized to kill insects, disease, and weed seeds. The trees in cans are ready from seed to planting size in six months on the average and are carried in trucks as far as possible then packed in special carriers on the backs of men to the plant-

ing site. This method of planting in soil is laborious and slow but it is certain. Recent counts made of our plantings show that we have obtained the following successful results with 4,684 trees counted:

| Age of Planting years | Per cent of survivals | Average height of survivals in feet |
|---|---|---|
| 1 | 94 | 4 |
| 2 | 95 | 20 |
| 3 | 93 | 6 |
| 4 | 86 | 16 |

Special attention has been given lately to reclaiming earth scars formed by excessive erosion in our red volcanic soils by planting the Swamp oak (*Casuarina glauca*), a root-suckering tree which in Australia usually grows in the river swamps. We have been particularly successful in getting this tree to grow in this sterile, mineral soil under almost drought conditions, especially where the holes are first dynamited.

Through helpful coöperation with the U. S. Army, seed has been sown from airplanes over recent burns and on denuded areas and subsequent examinations of rough areas thus seeded from the air have proved that this method of reforestation is successful.

One serious problem confronts the successful practice of forestry in the indigenous forests and this must sooner or later be solved by serious research. This is presented by the so-called staghorn fern or uluhi (*Gleichenia linearis*) which is an agressive, scandent fern which grows to a height of eight feet and forms a dense mat on the ground. It not only constitutes a serious fire menace in dry seasons with its mass of dead leaves and stems but prevents the natural reproduction of the native trees. Experiments conducted thus far in the attempt to get rid of it have led to no definite results of benefit. The solution seems to lie in the securing of a natural enemy which will wipe it out.

Owing to favorable moisture conditions, throughout most of the year, the forest fire problem is generally a negligable item but a well organized system of voluntary fire wardens, who are largely sugar plantation managers, takes care of what fires may start during a dry period.

The practice of forestry for water conservation is carried on in Hawaii entirely by appropriations made by the local Legislature with the exception of $2,000.00 contributed by the federal government for the coöperative distribution of planting stock to farmers under Section 4 of the Clarke-McNary law.

There is no winter in Hawaii to slow up the work and only in certain sections must tree planting be held up for lack of suitable moisture condition in the soil. Thus the work keeps going full blast practically the whole year around.

# THE BROWN HEART-ROT OF CALIFORNIA REDWOOD

## PART I. NOTES ON THE DEVELOPMENT OF THE CAUSAL FUNGUS

By EMANUEL FRITZ

*Associate Professor of Forestry, University of California*

## PART II. THE ETIOLOGY OF THE CAUSAL FUNGUS

By LEE BONAR

*Assistant Professor of Botany, University of California*

The authors present hitherto unpublished observations on a fungus causing much damage to the heartwood of California redwood. They describe the work of the fungus and some commercial aspects of the rot, the infrequent occurrence of the sporophore, the discovery of the latter, and the classification of the fungus as a new species—*Poria sequoiae.*

### Part I

THE common brown heart-rot of California redwood (*Sequoia sempervirens,* Endl.) has been known perhaps ever since the tree itself was discovered. It is mentioned in some detail but once[1] in the literature on redwood. It is so prevalent and causes such conspicuous loss of potential lumber,—from 12 to 15 per cent of the gross total,—that it would be difficult for anyone operating in the redwood forests to fail to note it, yet the fruiting body of the fungus causing the rot has defied discovery until very recently, and the fungus has therefore gone without classification. Although on the lookout for sporophores for eight field seasons while engaged in various studies in the redwood forests, it was not until the autumns of 1928 and 1929 that the author of this part found and collected some that appeared to be definitely associated with the causal fungus. Some of these were turned over to Dr. Bonar for study and he definitely established them as the fruiting bodies of the common brown heart rot fungus and the fungus itself as a new species of *Poria* for which he proposes the name *Poria sequoiae.* In Part II, Dr. Bonar discusses the morphology of the new species and his basis for its classification. The present paper concerns itself mainly with the writer's own field observations on the fungus and the occurrence of sporophores.

### Description of the Rot

In its typical form, *P. sequoiae,* inhabits the lowermost logs of infected trees. Frequently considerable rot of a similar kind is found in the upper portions but there is insufficient evidence that it is produced by the same fungus.

[1]Presented at the annual winter meeting of Pacific Division, American Association for the Advancement of Science, at Palo Alto, California, December 23, 1930.

When the top rot is present the tree may be sound at the base, or it may be heavily infected with *P. sequoiae* with no connection between the two rots. The rot caused by *P. sequoiae* may, for the present at least, be considered a "butt rot". It gains entrance through fire scars or other wounds. Since wounds other than those caused by fire are very rare, it is a safe conclusion that practically all of the heart rot in the basal portions of diseased trees is directly the result of the many generations of fires that have crept through the redwood forests.

The fungus reduces the wood to pockets of a deep brown charcoal-like "dry-rot" which, upon exposure and drying, cracks to form rough cubes. These pockets resemble those made in southern bald cypress (*Taxodium distichum*) by *Fomes geotropus* and resulting in lumber known as "pecky cypress", and those made in incense cedar (*Libocedrus decurrens*) by *Polyporus amarus*. The pockets are from very small to several inches across each way and up to eight or more inches long. Ordinarily they are thinly distributed in a central basal cone of discolored wood well within the outer limits of the heartwood. The height of the cone is usually under 20 feet but may exceed 40 feet. The dry-rot pockets are at first widely scattered but in the final stages they become so numerous or individually so much larger that they eventually make up an almost solid mass of rot, the units of which are separated only by occasional partitions of firm wood in which the substance toxic to fungi are perhaps so concentrated as to inhibit their growth. During the time the rot pockets are still widely separated the intervening and surrounding wood remains quite firm but it is discolored and is really in the incipient stage of decay. The discolored zone is nicely illustrated in Figure 3. Where the sound heartwood of redwood is a clear bright red on reddish brown, the wood of the discolored central diseased cone (except for the dry-rot pockets themselves) is a dull, lifeless brown. On cross sections the zone of discolored wood is fairly well defined from the surrounding bright sound wood and the compound microscope reveals in it the presence of many hyphae. Microtome sections cut from just outside the discolored zone showed the absence of hyphae.

Mycelial growths resembling a light bloom are often found on the surfaces of the deep brown cubes of advanced rot. Upon exposure they disintegrate. Occasionally sheet-like mycelial felts, four or more feet long, four or more inches wide, and about one-sixteenth to one-eighth inch thick, are found in the central checks or "rift cracks". Fluffy mycelial growth in the checks of the dry cubes of rot is common, Figure 4.

## The Sporophore

The first sporophore was found in August 1928 in a "rift crack" at the stump section of a freshly cut tree. The diameter of the stump inside the bark was about 50 inches; the rift crack crossed its center and much rot was observed in the heartwood. The sporophore, of a resupinate form, clung to the side of the wood facing the crack and extended for 12 inches or more

above and below the stump top. The second sporophore was taken on the same day in the hollow stump of a recently fire-and-wind-thrown tree standing about 20 feet from the first. This sporophore was attached at one point in a charred crevice about 12 inches from the ground. It was found in August and must have developed since the preceding June because in the latter month a very severe fire swept through the area and burned the hollow so much larger as to cause the tree to break off and fall. Other sporophores similar to this were found later in other hollow butts—but always in crevices and remote corners of the cavernous opening and always of approximately the same size—about 2 inches long and from three-quarters to one inch wide and somewhat curled.

In September 1929 the first sporophores were found on the ends of logs. The illustrations show their resupinate form, their snow-white color, and their occurrence on the area of firm but discolored wood surrounding the rot pockets. Some of them had reached a diameter of over six inches, but most of them were the size of a silver dollar or less. The sporophores found on log ends are of significant interest because they reveal the conditions required for their development and the reason why they have gone unnoticed so long.

A digression from the subject is necessary here to give a background to the finding of log-end sporophores. All the observations were made on redwood land in Humboldt County, California, in process of being logged. Often from 12 to 24 months elapse from the time the trees are felled until they are removed as logs to the sawmill. Before the trees are cut into logs they are peeled and the entire area is fired to remove the enormous accumulations of various kinds of debris. The next operation is "bucking" or cross-cutting, in which the prostrate charred trees are cut into log lengths. Some months after cross-cutting, the logs are removed, or "yarded", to the railroad and thence to the mill. In the present instance the trees were felled during the summer and autumn of 1928; cross-cutting took place the summer of 1929, and yarding commenced in the middle of September 1929. The season was one of unprecedented drought. Normally, occasional rains may be expected in August and September but in 1929 no rains fell until early in December. This drought contributed to the finding of the sporophores. Excellent specimens were found on two areas 60 miles apart, and could doubtless have been found on others had they been visited.

A very important fact is that log-end sporophores were found only when the diseased logs lay separated by only the space of the saw kerf. Where they rolled or dropped apart as the cross-cut was completed, no sporophores were found. In the first case the space between two logs is so small, under one-half inch, and the area of the log ends so large that only weak light can enter, humidity remains high, and temperature moderately cool; moreover, the conditions of humidity and warmth remain very uniform. The influence of light is probably only secondary. The small daily range of changes of temperature and relative humidity combined with their moderate intensity is probably the combination

promoting sporophore development. Where diseased logs became separated only a few inches, sporophores failed to develop—doubtless because the wider air gap permitted the temperature to rise higher and the humidity to drop lower with consequent dessication of the end surfaces. Sporophores thus develop apparently only under conditions of relative shade and restricted ventilation where temperature remains moderate and even and humidity high. Such conditions obtain in the narrow saw kerf spaces between two freshly-cut logs and in the protected recesses of the great hollows one so frequently finds burned into the bases of redwood trees. These hollows, locally known as "goose-pens" are well known as being cool, damp, and relatively dark, but only in the remoter corners are the conditions least affected by outside extremes and thus made favorable to sporophore production. It is thus evident that *P. sequoiae* produces sporophores only under infrequently occurring combinations of favorable conditions.

The sporophore is readily attacked by such mold-producing fungi as species of *Penicillium*, especially when it is rain soaked. The frequency of rains except in summer in the redwood region doubtless causes many sporophores to disintegrate before they have grown large and conspicuous. Unless broken by rains the dry summer season gives them full opportunity to develop and reach the sporulating stage.

Under favorable conditions sporophores develop rapidly. A log sawed on August 8 and removed September 18 revealed the development in the intervening 41 days of a sporophore covering about 40 square inches; another, sawed on August 12 and pulled out September 30, or 49 days later, had a sporophore of similar size plus one of much greater though broken area. Sporophores are thus hidden until the logs are pulled apart during yarding, and it is only as logging progresses that one finds them, either in the woods or after the logs arrive at the mill.

## Progress of Heart Rot after Felling

Several butt logs, because of excessive rot, were abandoned in the woods by the loggers and thus gave an opportunity for more intensive study. A large block cut from one of them, Figure 3, was brought to the laboratory and provided material for Dr. Bonar's examination and for the author's study of the progress of decay in the discolored wood. On December 5, 1929, a saw cut was made half-way through another log, Figure 1, and about 20 inches from its end, to see if another sporophore would form in the new saw-kerf space. Due to a long absence from the State the log was not again visited until the following October 11, two years after the tree was felled, when the partially-sawed end was split off. Exposure of the new end revealed the remains of a large area of sporophores. Several heavy rains of the preceding 30 days developed a heavy growth of *Penicillium* upon it and while it was easily recognized, it was in very poor condition. Incidentally, this log had been subjected to a severe accidental fire about 30 days earlier. This fire burned the rotten core to a hole of 20-inch diameter and doubtless

contributed to the destruction of the sporophore although the latter was protected from it by the large mass of wood. On the same day, October 11, 1930, excellent sporophores were found on the ends of several large logs after they had reached the sawmill from another area. When the logs are left in the mill pond more than four or five days, the long immersion is likely to cause the disintegration of sporophores and they escape notice.

It is generally believed in the redwood region that once a diseased tree is cut, the fungus itself succumbs. The correctness of this belief has been under suspicion some time and observations made in this study prove it to be a fallacy. The case just cited of a sporophore developing two years after felling is one evidence. Another is that of a windfall, apparently sound, which had lain on the ground at least five years, and possibly considerably over ten years, and which was cut into logs on August 29, 1929. On October 4, or 36 days later, the logs were pulled apart only to find some advanced decay in the heart and excellent sporophores on each end, Figure 2. Evidently the fungus was actively at work and ready to produce sporophores when the conditions became favorable.

## The Commercial Aspect of the Discolored Wood

As previously stated, the central core of discolored wood, in which occurs the pockets of dry rot, is in an incipient stage of decay. Because it is as firm as the surrounding bright, sound wood and because the difference of color between the two is not readily detected in freshly sawed boards, much of it finds its way into commerce. Redwood has a reputation of exceptionally high durability when used in contact with the ground. Yet occasionally there are reported cases of premature decay. It is quite likely that most of such failures can be attributed to the presence of discolored wood carrying incipient decay. To test this out in actual service, stakes measuring 3 x 3 x 30 inches were cut from a 70-inch log from both sides of the line separating the sound wood from the discolored wood. They were placed in garden soil on December 28, 1929. The conditions for decay here were unfavorable during the year following so that nothing definite can be reported as to the behavior of the two types of wood. They will again be examined in December 1931. It is safe to suggest, however, since the mycelium is known to be present in the discolored wood, that such wood should be excluded from uses where decay resistance is important.

## Relation between Rot and Fire

Practically every one of the several hundred cases of heart rot examined at the stump section in this study showed that at one or more times the trees had been subjected to damage by fire. Some fires were dated back over 1,000 years and there was ample evidence of several severe fires each century. The association of rot with fire scars is so perfect that one can safely say that a fire scar is almost always the precursor of the brown heart rot, *P. sequoiae*. Repeated

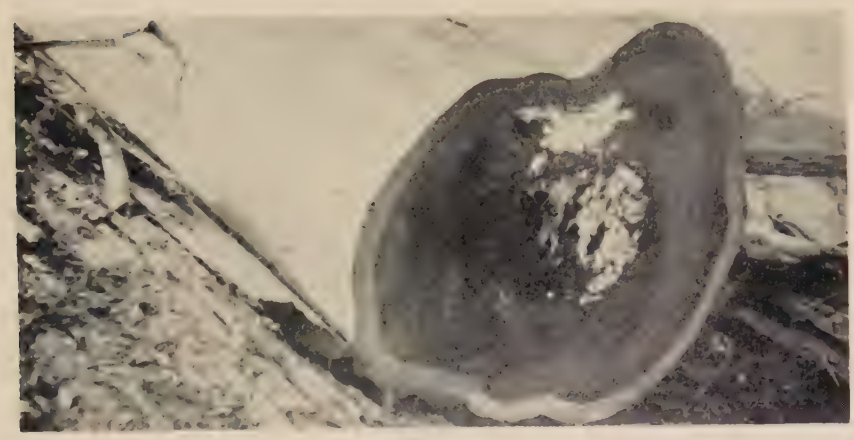

FIG. 1

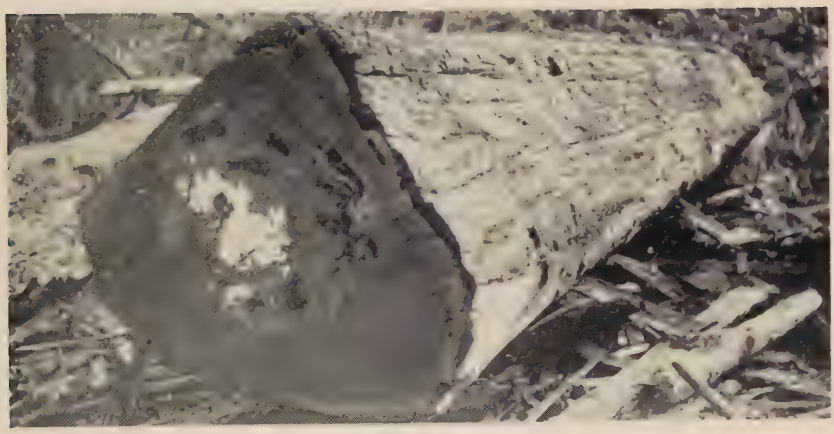

FIG. 2

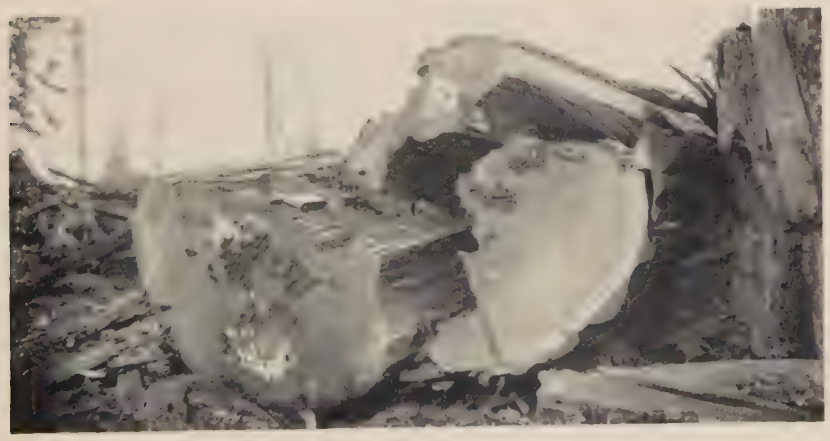

FIG. 3

*Cuts furnished by University of California*

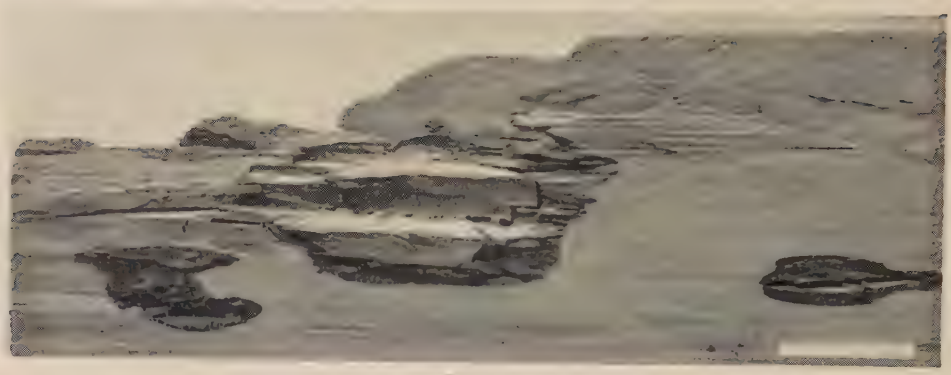

FIG. 4

FIG. 5

FIG. 6

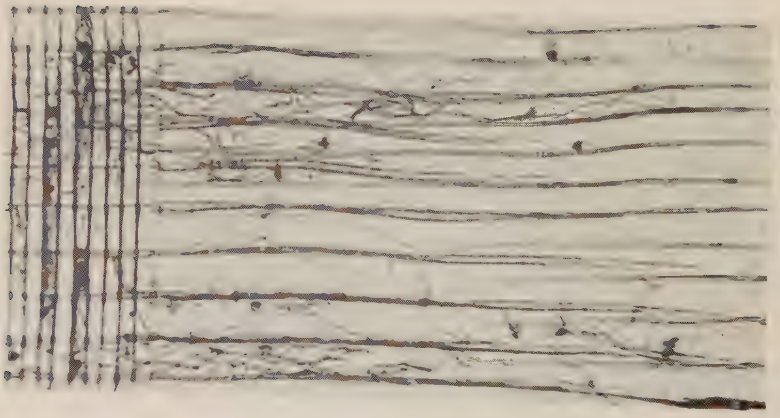

FIG. 7

*Cuts furnished by University of California*

## Explanation of Figures

Fig. 1.—Top end of a large butt log, Tree 757, showing sporophores of *Poria sequoiae*. The tree was felled August 24, 1928, crosscut on August 12, 1929, and the logs were pulled apart on September 30, 1929, revealing the sporophores. A saw-cut was made half way through the log, 20 inches from the end, on December 5, 1929, and the piece split out on October 11, 1930, revealing a new crop of sporophores.

Fig. 2.—A windfall, Tree 1350, sawed into logs August 29, 1929. On pulling the logs apart 36 days later the sporophores here shown were revealed. This log also shows the typical rot pockets.

Fig. 3.—Tree 1243, 70 inches in diameter at this section, 25 feet from the ground. A large block was taken from the upper chunk and used for laboratory material for identification of the fungus and for stakes for an experiment to determine the rot-resistance of discolored wood. Note the line of demarcation between the sound wood and the discolored wood in the lower right chunk, also that the sporophores are restricted to the discolored zone.

Fig. 4.—Typical rot pockets from which cultures were made.

Fig. 5.—Six-months old culture of *Poria sequoiae* in Roux tube, showing the formation of the sporophores at upper end of block.

Fig. 6.—Two views of pocket of typical rot produced in sound wood six months after inoculation with pure culture of *Poria sequoiae*.

Fig. 7.—Photomicrograph of radial section from block shown in Figure 6, section taken from near the end, away from the rot pocket.

fires enlarge the fire scars into great cavities, some of them large enough to house a small automobile. Locally they are known as "goosepens". If, as is usually the case, a large amount of rot develops in the wood above the cavity, the next fire finds it much simpler to enlarge the hole a much greater amount than did its predecessor. The heart rot is not a tree-killing disease but in company with frequent fires the butt of a tree is eventually so weakened that the tree topples to the ground.

### Possible Infection of Young Growth

Foresters who are familiar with the prevalance of the heart rot in old growth have raised the question of the possible infection of young growth. It happens that in 1923 the author cut approximately an acre of 65-year-old young growth. Many of these trees were sprouts or suckers from huge trees which were originally badly decayed. All sprouts except those which had been injured by fire were found to be perfectly sound. Those sprouts which had been fire-scarred showed the presence of decay of the same type common in old growth. Without doubt the responsible fungus is the same as the one found in old trees. Freedom from infection of young growth thus lies in the protection of the butts from damage by fire or other causes.

### Bark Rot

It is interesting to note that a dry rot similar to the heart rot described above was found in the thick outer bark of 30 or more large redwood trees. This rot was traced in some cases for a number of feet—in one case over 12 feet—without finding a connection between it and rot in the woody portion of the tree. This bark rot has the same cubical form as the heart rot of the wood and resembles it in other respects. No sporophores have been found. *P. sequoiae* may be the causal fungus but the great difference in host warrants one to suspect otherwise.

### Summary

Sporophores have been found of the fungus producing the common brown heart rot of redwood. They require moderately cool and even temperatures and high relative humidity for their development, and they may be quickly spoiled by mold-producing fungi following soaking by rains. Sporophores were found in hollow butts, in a rift crack, and on log ends; the latter type occurs only where the logs lie very close together, end-to-end. The fungus has been identified as a new species of *Poria* by Dr. Lee Bonar, who has named it *Poria sequoiae*. It is the most destructive disease in redwood, causing a loss of from 12 to 15 per cent of the merchantable contents of a stand of timber. Though not a tree-killing disease it weakens a tree mechanically and promotes the spread of fire in the trunk, causing many trees to fall in each conflagration. Most of it gains entrance through fire scars. Incidental to the major observations of rot in the wood, a dry rot was found working solely in the thick outer bark of the trees.

## Part II

The brown heart-rot in *Sequoia sempervirens* has been the subject of concern for many years, but until very recently, as noted in Part I, we have had no records of any sporophores of the causal fungus associated with the rot. The sporophores, collected by Professor Fritz, were brought to my laboratory and a study for the determination of the fungus was undertaken. The sporophores show that the fungus belongs to the genus *Poria* of the family *Polyporaceae.* They may be characterized as follows:

Effused for several centimeters, or very small, very closely attached, and separable from the matrix with difficulty. In most cases it was not possible to separate the sporophores from the log-ends without breaking them up to a considerable extent. Margin of the sporophore consists of a sterile zone 1 to 2 mm. wide, very thin, and closely appressed; subiculum very thin, averaging 0.25 to 0.5 mm. in thickness; white. Pores 1 to 2 mm. long or up to 3 to 4 mm. in a vertical position, becoming oblique in the vertical position; surface white when fresh, becoming light buff in dried specimens; mouths circular to oval, averaging 4 to 5 per mm., glabrous; basidia 4 spored, 12 to 15 x 5 microns; paraphyses abundant; spores ellipsoidal, smooth, hyaline, apiculate, 4.5 to 6 x 2 to 3.5 microns; cystidia none; tramal hyphae 2.5 to 3.5 microns in diameter; clamp connections present in the tissue of the subiculum.

Found growing from the heartwood of *Sequoia sempervirens,* adjacent to areas affected by the brown heart-rot, in locations where the end of the log was protected from light and drying to some extent, as in the saw kerf. Not found on exposed ends of logs, even if the rot be present there.

This fungus resembles *Poria ornata* (Pk) Sacc. (3) very closely in some of its morphological characters. It differs from *Poria ornata* however, in that the margin of the sporophore is thin, and has a smooth surface, whereas that of *Poria ornata* is characterized by having a thicker margin marked by peculiar depressions which carried drops of water when fresh, and remain as depressions in the dried specimens. The pores of *Poria ornata* are given as 3 to 3.5 per mm., by Overholts (1) who made a careful re-study of the species of Poria described by Peck, while those of our species are smaller, averaging 4 to 5 per mm. in dried specimens. Another character that sets off our species very markedly from that of Peck is its habit of growth. Peck's species was found growing on the surface of prostrate trunks of deciduous trees, while our species is found only in very peculiarly limited situations, as has been mentioned on redwood, and associated with this particular brown heart rot. The fact that this rot has been known for a considerable period of time, and the sporophores not observed by men who have made a study of it, is evidence that they are not readily discovered.

Having made these studies on this material we have come to the conclusion that we are here dealing with a plant that has not been described, and are proposing for it the name *Poria sequoiae* sp. nov.

The important question arising in connection with this study is whether this *Poria* has been the cause of the rot in the logs where it has been found. Professor Fritz brought in to the laboratory a section of a log showing the typical brown crumbly rot in the center of the log, with the discolored area extending some distance beyond the rot pockets toward the periphery. This section was about three feet long and about two square feet in cross section.

A block of wood was taken from the center of this section. This block showed pockets of the rot and the usual intact wood. When this was split open, the rot pockets in the central part were very moist, and showed white mycelial growth between the fragments of the rotten wood, Figure 4. Portions of this rotten wood were carefully removed with sterile instruments to sterile containers, as well as small blocks of the discolored wood within one inch of the edge of the rot pockets. Other similar blocks were cut from the wood 6 inches away from the rot pockets. These blocks were cut out with a carefully sterilized chisel. The surfaces of these small blocks were sterilized by heat and isolations of small fragments were made from the interior and planted on 2.5 per cent malt extract agar, on October 24, 1929.

Eight plantings were made from the tissue of the typical rot, Figure 4, and each of these showed a growth of mycelium in the cultures in a few days. Six of these appeared as cultures of a single fungus, while the other two showed this same fungus plus a contamination of *Penicillium*, and were discarded.

These cultures gave a very uniform type of growth, of white spreading mycelium which became aggregated into strands of intertwined hyphae and spread rapidly over the surface of the agar. A microscopic examination of the mycelium in these cultures was made and it was found to be that of a basidiomycete, by the presence of numerous clamp connections which are characteristic of the mycelium of many of the Hymenomycetes.

Five plantings from wood within 1 inch of the edge of a rot pocket gave the following results: 1 positive for the basidiomycetous fungus mentioned above, 1 contaminated by *Pelicillium* and 3 remained free of any fungus growth.

Six plantings from wood 6 inches from a rot pocket all gave fungus growth. The initial growth was very different from the basidiomycetous mycelium described above, bearing numerous conidia on hyphal branches, and its identity has not yet been established. Three of the six plantings did show a mixture of this fungus and the above mentioned basidiomycete, after about two weeks time.

Repeated studies and cultures made on the basidiomycete isolated from all the areas tested showed that those obtained from the first mentioned cultures from the rotten wood were pure cultures of this fungus. These pure cultures were planted on agar in Roux tubes and allowed to grow for 18 days.

Blocks of sound bright redwood, from 4 to 5 inches long and about an inch in diameter, were split out from dry seasoned lumber from the forestry laboratory, and placed in large-size culture

dishes in distilled water and sterilized in an autoclave at 7 pounds pressure for 30 minutes. Similar blocks were dipped in 95 per cent alcohol and then flamed, and this was repeated. These blocks were then put in sterile distilled water and allowed to stand for 3 days. Each of these sterilized blocks was then introduced into one of the Roux tubes containing a growing pure culture of the fungus so that the lower end of the block just came in contact with the upper portion of the agar slant. These culture tubes were then capped with tinfoil, to prevent too rapid loss of water, and set away in the dark at room temperature.

Observations from time to time showed that the mycelium made a very rapid growth and soon began to grow up over the surface of the wood blocks, in every one of the cultures. No differences could be seen in the growth on the blocks that had been autoclaved and on those that had been flamed from alcohol, although 2 of the 5 flamed from alcohol developed contaminations of *Penicillium* and had to be discarded.

After two months time these cultures showed the blocks completely covered by a very abundant growth of the white mycelium of the fungus, and in one or two of the cultures could be seen the formation of small white fruiting bodies. By the end of three months some of these small fruiting bodies could be seen to have formed pore surfaces, and a removal of these fruiting bodies for study with the microscope showed them to be *Porias* and the spores and basidia to be exact correspondents of those that had been found in nature in the woods.

The remainder of the cultures were allowed to stand until six months from the time of planting and by that time every one of them showed the formation of at least one small abortive sporophore. These sporophores were formed either on the ends or on the corners of the blocks at the upper end of the culture, and the largest that was found was 0.5 x 0.75 cm. in area. They were pure white at first, later becoming buff-colored. These do not correspond very well with the sporophores that were found in the woods, as to external morphology, but it is a well known fact that the sporophores developed in cultures are very often atypical. The structure of the pores, spores, and basidia did, however, agree with those that were found in nature and we feel that there is no doubt that they are the same fungus.

An examination was then made of the blocks from the culture tubes, after six months exposure to the growth of the fungus. All these showed discoloration of the interior of the blocks and some showed the wood to be sufficiently decomposed that it would crumble under the cutting edge of a knife. The block that showed the most typical and largest sporophore on the upper end was cut off a short distance below the sporophore and showed a very typical pocket of complete brown rot in the central part of the block. A photograph, Figure 6, of this rot pocket will show how complete was the rot in this instance. The remainder of the wood in these blocks showed a brown discoloration, like that found in the trees in the areas adjacent to the rot pockets.

Microscopic examination of the wood from the interior of these artificially

infected blocks showed that the mycelium of the fungus had penetrated the wood to a very high degree, and was present in abundance in the discolored wood of the blocks that did not show the complete breakdown of the wood. A comparison of the microscopic findings in the blocks that show the greater degree of decay, with that of the decayed wood from the forest, shows a high degree of correspondence. Sections of the completely decayed wood from the typical rot pockets in the tree, show that the tracheids are surprisingly regular and intact, with little evidence of the mycelium present within the cells. No mycelium will be found in repeated preparations and as a rule no bore holes in the walls of the tracheids, to show where there has been penetration of the cell walls by the hyphae, although rare and occasional holes may be found. The completely decayed wood from the culture blocks gave a duplicate picture of that to be found in the rotten wood from the forest, while abundant mycelium was found to be present in the portion of the block that had not as yet reached the more complete stages of decay. The presence of the mycelium in the wood is shown in Figure 7, and it will be seen that the path of growth is longitudinal in the tracheids, and no evidence could be seen of penetration of the walls of the tracheids by the mycelium. The hyphae pass from one cell to another through the pits and sometimes very completely fill the space between the torus and the outer border of the pit. The disappearance of these hyphae in the completely rotted wood, from the cultures, again corresponds with what we find in the material from the forest.

Therefore, since I have been able to produce this rot in sound wood in the laboratory cultures, with a pure culture of the fungus, and this rot gives a duplication of what we find in nature, I feel that there can be no doubt that the *Poria* that we have under consideration is the cause of the brown heart rot.

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# THE GROWTH OF JACK, NORWAY AND SCOTCH PINE PLANTATIONS ON HINCKLEY LOAMY FINE SAND

By J. H. ALLISON

*Professor of Forestry, University of Minnesota*

Some rapid growth of three species of pine on a poor soil in Minnesota is reported. Explanations are offered which suggest at the same time a wider field for these species and the possible conditions necessary to repeat elsewhere the rapid growth of the sample plots.

IN MAY 1918, several acres of very light, sandy soil at Lake Vadnais, near St. Paul, Minnesota were planted to Norway pine (*P. resinosa*), jack pine (*P. banksiana*), and Scotch pine (Riga variety) (*P. sylvestris*). The Norway and jack pines were planted in alternate rows, the Scotch pine in a pure stand. In making these plantations, 2-2 Norway pine and 2-1 jack and Scotch pine stock, grown at the Cloquet Forest Experiment Station, was used. The Scotch pine seed was obtained from the Riga region of Russia in 1912, by the U. S. Forest Service.

The soil upon which the plantations are growing is classified by the Bureau of Soils, U. S. Department of Agriculture, as Hinckley loamy fine sand (2). The productivity of this soil is considered to be very low, lower than that of any other mineral soil found in this region. It consists of a gray, loamy, fine sand, having a moisture equivalent of 3.5 per cent for the first foot, 1.5 per cent for the second foot and 2.6 per cent for the third foot. The substratum, lying below the 3-foot level, is somewhat coarser textured than the upper layers. This sand is non-calcareous, water-laid, and of glacial origin. After the disappearance of the glacier it was probably occupied by jack pine for a considerable period of time before the oaks now occupying it moved in. On similar soils, located a few miles to the northwest, a few isolated natural stands of jack pine still occur.

Prior to being planted to pine, the area was occupied by a stand of very scrubby oak, in which the mature trees varied from 15 to 30 feet in height. In this stand, jack oak (*Q. ellipsoidalis*), predominated. The oak was cut for firewood about five years before the area was planted to pine. There are a large number of small oak sprouts growing among the planted pines. For many years prior to planting the area was burned over every spring. The land was prepared for planting by plowing furrows about five and one-half feet apart. The pines were planted in the furrows, about five feet apart.

About the first of May, 1928, ten years after planting, one representative one-half acre sample plot in the Scotch pine, and two representative one-quarter acre sample plots in the jack pine-Norway pine, were laid out and measured. The development at that time is shown in Table I.

TABLE I

DEVELOPMENT OF JACK, NORWAY AND SCOTCH PINE ON HINCKLEY LOAMY FINE SAND AT 10 YEARS OF AGE

| | Jack pine | Scotch pine | Norway pine |
|---|---|---|---|
| Stock used in making plantation | 2-1 | 2-1 | 2-2 |
| Percent of original stand surviving at end of 10 years | 80.3 | 81.3 | 55.7 |
| No. of trees surviving (acre basis) | 1644 | 1192 | 1104 |
| D.b.h. basal area (acre basis—square feet) | 32.556 | 13.944 | 2.740 |
| D.b.h. (inches)—minimum | 0.0[1] | 0.0[1] | 0.0[1] |
| maximum | 3.1 | 2.9 | 1.9 |
| average[2] | 1.9 | 1.4 | |
| Height (feet)—minimum | 3.5 | 1.5 | 2.0 |
| maximum | 16.5 | 14.0 | 10.5 |
| average[2] | 11.86 | 8.40 | 5.88 |
| Average mean annual height growth (feet) | 1.14 | 0.774 | 0.538 |
| Ave. height on this soil of the trees on an adjoining plot at 5 years of age (feet) | 2.16 | 2.31 | 1.47 |
| Estimated mean annual height growth for the second 5 years of the period (feet) | 1.95 | 1.22 | 0.88 |

[1]0.75 percent of the jack pine, 25.3 percent of the Norway pine and 3.7 percent of the Scotch pines had not reached 4.5 feet in height.

[2]The median diameters and median heights were almost identical with the average diameters and average heights.

If the rate of tree growth on the Lake Vadnais plots is compared with that reported by Kittredge (1), it will be found that the growth of the jack pine is somewhat more rapid on the very droughty, sandy land at Lake Vadnais than is its growth as reported by Kittredge on either his "jack pine-oak sands" or on his "better sand or sandy loam soils," although this soil seems to correspond more clearly to his "jack pine-oak sands" than to his "better sand or sandy loam soils." Norway pine, on the other hand, is not growing as rapidly at Lake Vadnais as the maximum rate reported by Kittredge for either of the soils just referred to. Scotch pine is growing more rapidly at Lake Vadnais than it is on any of Kittredge's "jack pine-oak sands," but not as rapidly as upon his "better sand or sandy loam soils" plots. A summary of the rates of growth of jack, Norway, and Scotch pine reported by Kittredge is given in Table II.

Although sandy soils are particularly subject to drought, the rapid growth of the Lake Vadnais plots, as compared with those reported by Kittredge for the same species upon soils which are probably quite similar, cannot be accounted for by the precipitation situation at Lake Vadnais. The average annual precipitation for the ten year period 1918-1927, covered by the growth of the Lake Vadnais plots here reported, was 26.06 inches. This 1918-1927 average is 1.61 inches below the 1871-1927 St. Paul mean annual precipitation, and is distinctly below the mean annual precipitations reported by the Weather Bureau (3) for the eighteen stations located in the "cut-over" regions of Wisconsin and Michigan used as a check. Perhaps of greater importance is the precipitation received during the growing season, May to September inclusive. The St. Paul average for the 1918-1927 period was 15.95 inches, with a minimum of

TABLE II

AVERAGE RATE OF GROWTH OF JACK, NORWAY AND SCOTCH PINES ON SANDY SOILS, "WITH LESS THAN 40 PERCENT TREE COVER" AS REPORTED BY KITTREDGE

| | Jack pine—oak sands | | | Better sand or sandy loam soils | | |
|---|---|---|---|---|---|---|
| | Jack Pine | Norway Pine | Scotch Pine | Jack Pine | Norway Pine | Scotch Pine |
| Average mean annual height growth of: Fastest growing plot (feet)[1] | 0.90 | 0.63 | 0.68 | 1.00 | 0.64 | 0.97 |
| All plots (feet)[1] | 0.58 | 0.26 | 0.45 | 0.70 | 0.30 | 0.65 |
| Total height, 10 years after planting: Fastest growing plot (feet) | 9.0 | 6.0 | ____ | 10.0 | 6.0 | ____ |
| Average of all plots (feet) | 5.6 | 2.6 | ____ | 6.9 | 3.0 | ____ |

[1]These heights are estimated by interpolating "Figure 6" in U. S. D. A. Bul. 1497.

12.09 inches in 1923. This average is 1.58 inches below the 1871-1927 St. Paul average, which, in turn, is lower than that of the eighteen "cut-over" Michigan-Wisconsin stations used as a check. During the 1918-1927 period the Lake Vadnais plots were subjected to one severe summer drought (1925) and three ordinary summer droughts.

Perhaps the rapid growth on these plots, as compared with the growth on those reported by Kittredge, was due to the fact that the trees were planted in the open, in furrows. During the first two or three years after planting the furrows reduced the competition of other vegetation with the planted trees and undoubtedly increased the amount of moisture available to the trees during that period.

Although these plantations are still very young, and their development in the future may not be as good, relatively, as it has been in the past, they indicate that certain tree species grow fairly rapidly on the droughty, sandy soils found in the region lying directly north of St. Paul. Furthermore, they indicate that these species, when properly established, may be expected to grow as rapidly upon the sandy soils just referred to as they do in the originally forested region of the Lake States. As far as agricultural use is concerned these soils are to be considered submarginal. It appears that they are adapted to growing of jack, Scotch (Riga variety) and Norway pine timber.

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# IS SILVICULTURE POSSIBLE IN AMERICA?

By WARD SHEPARD

## Article III—Realism in Education[1]

Discarding the "let-alone" theory, the author proposes as part of a more realistic program of private forestry the intensification and re-orientation of education and extension. Foresters must be fully trained in the realities of current exploitation in order to reform it. The author urges more research aimed at immediate modifications of forest exploitation; a great program of small demonstration forests; the full training and utilization of the Agricultural Extension Service for the rapid extension of farm forestry; and a fully organized national plan of improving the exploitation of commercial forests.

IF A PROGRAM of realism in private forestry is to be substituted for a policy of *laissez-faire,* the first step consists in strengthening public and quasi-public agencies of education and extension and concentrating their efforts on the reform of logging methods in private forests. Such a program must take its start from certain fundamental principles: First, that forests are a necessity to civilization justifying large public effort for their maintenance; second, that marked improvement in forest exploitation is possible under present economic conditions; third, that the art of silviculture is so new and unknown that forest owners must be carefully and patiently guided, step by step, in the processes of better forest exploitation; and, fourth, that dependence on the passive and ineffectual forces of "economic evolution" instead of organized effort will continue the needless and inexcusable process of forest destruction.

I have dealt elsewhere[2] with some of the general needs of a realistic program of education, distinguishing sharply between generalized "shotgun" propaganda and specific guidance in remedying destructive processes. The present article deals with the development of specific educational instruments to deal more effectively with forest exploitation as it exists today. Naturally, considering the difficulty and intricacy of the subject, only a cursory treatment can be given in the space of an article.

### Realistic Training of Foresters

In the long run, the effectiveness of organized educational agencies for promoting better forest practices will be determined by the basic training of foresters. If we as a profession are dissatisfied with some aspects of the training of foresters, it is only part of a widespread reformation of present scholastic educational methods in general. Modern educational theory assails traditional methods of scholastic education on the ground both of shallowness and of ineffectiveness. Superficiality, scat-

[1]Articles I and II appeared in the December 1930 and February 1931 numbers respectively of this Journal.

[2]"The Necessity for Realism in Forestry Propaganda", Journal of Forestry, January, 1927.

teration, aversion to thoroughness are obvious characteristics of American education. But the criticism goes deeper. Traditional scholastic methods emphasize the memorization of facts, rules, principles, and systems, and tend to ignore education as the building up of creative mental processes, capable of realistic and penetrating analysis of facts and actual situations.

Forest school education suffers in some respects from these same defects. In general, forestry education needs to give more attention to training foresters to grapple realistically with the living facts of the American forest situation—industrial, mechanical, economic, and human. Some forest educators may reply that forest education has of necessity been confined to *principles* rather than *concrete situations*. But in fact, it has not dealt primarily with either. In the main, it has from the start emphasized systems (in essence European) rather than the analysis of concrete and living situations as a means of deriving principles of action. And principles of action are what the American forest situation is loudly crying for.

This difference may be shown by the old-fashioned and the modern methods of teaching law. Formerly, law was taught from text-books of "principles," which were in reality abstract statements of the general trend or tenor of court decisions. The modern teaching of law, on the contrary, is based almost wholly on the study of actual cases—thousands upon thousands of them—so that the student, instead of memorizing "principles" of law, does the infinitely more difficult and useful thing of learning to derive his own principles from the raw material of legal conflict. When therefore he is confronted with cases in actual practice, he is able to grapple with them realistically. Now, education in silviculture, forest economics, etc., if largely confined to general manuals (such as Schlich), or even to academic working plans and forestry exercises in the woods, misses a vitally important contact with living realities. There is abundant opportunity to further develop the "case" system of studying American forestry, with case material ranging from actual working plans of going enterprises to the field study of modifying commercial logging methods and of dealing with living economic forces.

The education of foresters must deal more fully with actual situations (e.g. the modification of present exploitation methods, current industrial economics, overproduction, marketing, and the like) if foresters of the future are to be fully trained to grapple with the realities of American forestry. The wide gap between abstract systems of silviculture and management and the brutal realities of American logging has undoubtedly helped to tinge our thought with the pessimistic feeling that nothing can be done to change these practices; whereas a realistic education, taking actual logging for its starting point, would lead foresters to a continuous analysis and modification of the individual steps in these processes, which in turn would give them a powerful leverage with the management. It is precisely this realistic grappling with facts that the most successful private and consulting foresters are using to such good advantage.

### Research as an Instrument of Change

If education is the tool by which human behavior is changed, research is an important means through which it finds convincing reasons and feasible methods of change. Forest research has in recent years been one of the most vigorous forces in the forestry movement. It has naturally given much attention to the technical aspects of silviculture and utilization. We may reasonably suppose that while continuing to develop vigorously along its present lines, it will also perforce give more and more attention to the pressing immediate problems of forest and factory management. In this way research will be more fully developed as an *instrument of change.* By this I mean that it will put great emphasis on finding *workable and acceptable modifications* of existing processes of logging, manufacture, utilization, and marketing. To this end, it will begin with the given process, sketch out desirable changes, and accurately test these changes in the closest collaboration with management.

Past studies of selective cutting are good examples of this use of research. On the other hand, I have seen highly abstract silvicultural research (thinnings, shelterwood cuttings, etc.) side by side with logging processes that destroyed a third or more of the advance reproduction, with the researchers taking little interest in the logging and the loggers taking less interest in the research. Why not integrate the two? Why not, in this particular case, find out precisely how much reproduction is being destroyed and how much it would cost to change the logging method?

In each forest region of the United States there should be a well-financed research project, carried out with the active participation of industry, on feasible means of modifying logging to permit forest regeneration. In forest industrial economics, there is an acute need for more research that tells not merely what things are happening, but why they are happening and how these trends can be changed, or at least avoided. Wood substitutes, for example. As an example in another field may be cited the elaborate research on future population changes in specific localities as the basis of telephone construction and planning. This kind of forest research is not new; we merely need a great deal more of it.

### Ocular Demonstration

Among its many weaknesses, the *laissez-faire* doctrine has assumed that better economic conditions would bring an automatic response in better forest practices. This is only one more proof of the uncritical assumptions that make up this doctrine. We might as well say that an abundant supply of cheap paints would automatically evoke whole troops of Rembrandts and Tintorettos. For forestry is a complex art, with many difficulties. Even in its simplest aspects it is to the overwhelming majority of landowners an unknown thing, entirely outside the range of their experience and imagination. The biological processes of forest reproduction and growth are mysteries to them. Anyone who has struggled to impart to woodsworkers

such simple things as proper methods of slash disposal will understand the difficulty of giving to the average layman a comprehensible idea of the successive steps of good forestry practice.

For this reason there is need for a very great increase of demonstration forests, federal, state, county, institutional, and private. Existing demonstration forests have amply proved their worth in making forestry comprehensible to the lay world. One demonstration forest to every forested county in the United States would not be too many. These forests need not be large —a few hundred acres to one or two thousand are sufficient.

The federal acquisition program might well be modified to permit the purchase of numerous small demonstration units of from one thousand to five thousand acres; and there might well be also financial coöperation between the federal government and the states to stimulate purchases of demonstration forests. A small federal appropriation for this purpose could accomplish much, as witness the great stimulation of state nursery work by a federal appropriation of less than $100,000.

With the growing interest in demonstration forests, a few basic principles need to be emphasized:

1. A managed forest (such as a national forest) is not *per se* a true "demonstration forest" merely by virtue of its existence. The wise saying, "They also serve who only stand and wait" was never meant to apply to demonstration forests. They must be demonstrative in every sense of the term. They are demonstration forests only if they have a personnel specially trained in extension methods and employ direct and aggressive methods to convert as many people as possible to good forestry practice. In other words, their main function is *education* rather than *forest management.*

Unless this vital distinction is firmly grasped, federal acquisition for demonstration is not likely to achieve its purpose. The typical large national forest unit is operated for economical timber production and watershed protection. Its regular personnel is not specially trained for demonstration nor will their major duties permit devoting more than incidental time to demonstration. The full educational value of the regular national forests can probably only be developed by setting aside small demonstration units under specially trained personnel. In addition, there is need for a large number of widely scattered small federal units (1000 to 5000 acres) solely for demonstration and not handicapped by the necessity for large scale administrative economies. This need is all the greater because it seems probable that timber-growing in the eastern United States will be largely on small units of from 1000 to 10,000 acres.

2. It is sometimes assumed that the chief purpose of demonstration forests is *to prove that forestry is profitable.* On the contrary, their main purpose is *to demonstrate methods for improving the condition of woodlands and better methods of utilizing and marketing their products, within limits of reasonable cost or labor.* This distinction is important. What living human being can say that pruning fifteen-year-old white pine will or will not show a profit fifty years hence when the tree is cut? Must

we wait fifty years before we can demonstrate pruning? We can, on the contrary, safely assume that cultural operations involving feasible and reasonable outlays of money and labor (both of which will vary with the circumstances and purposes of the owner) will create a more valuable and productive property. If, in addition, we can definitely demonstrate a quick profit from a given operation, so much the better, and if over a long period of years a well-managed forest such as the Harvard Forest shows a continuous profit, better still.

We must, moreover, give full recognition and weight to the non-profit-making motives, such as the instinct for good workmanship. A well-managed farm woodlot is more satisfying and interesting than a decadent one. Moreover, strict bookkeeping does not always apply to human affairs. If a farmer who can't sell his labor in winter devotes it to thinning his woodlot, just how much does the thinning "cost"?

3. The main immediate purpose of demonstration forests is not to demonstrate perfect and conclusive silviculture any more than to demonstrate guaranteed and provable profits. Rather, their practical function is to give ocular and manual instruction *in the actual processes by which woodlands are improved.* Demonstration must therefore be dynamic rather than static; it must so far as possible enact the process (weeding, thinning, selective cutting, etc.) with the learners as the actors rather than display a "museum piece" in the way of a perfect and finished sample plot, with no indication of the steps by which it was achieved. "Demonstrate with the axe" should be the first motto of the demonstration forester. Moreover, recognition of this principle means that demonstration can begin at once instead of waiting years to develop model examples of silviculture. For the demonstration forest and the private forest have the same objective: To improve run-down or at least unmanaged woodlands; and the successive steps by which the improvements are made are the important things to demonstrate at this stage.

4. Since the main function of demonstration forests is *education,* demonstration forests must be schools, presided over by trained teachers. It is vital to the success of the demonstration forest movement that education should be fully recognized as a technology and art distinct from the technology of forest management. Consequently, demonstration foresters must be well trained in educational theory and practical extension methods; and demonstration forests must make full use of all the arts of dealing with people and changing human behavior.

## An Adequate Program of Farm Forestry

Overproduction of food crops gives an especially potent reason for the development of a highly organized program of farm forestry, including cooperative marketing of forest products. Moreover, farmers (with proper guidance) are in the best possible position to practice high-grade silviculture, the only kind that will pay in the coming glut of low-grade timber that will result from protection without silvicul-

ture. It is easy to discount the importance of farm forestry, but the vast aggregate area of farm forests and the chance for rapidly improving their condition make these forests of prime importance.

Through its affiliation with farm cooperative agencies, the Federal Farm Board is in a strategic position to promote farm forestry; and its interest in reducing the cultivation of marginal lands gives it a strong motive for promoting farm forestry and tree-planting, public forest acquisition directed especially to reducing marginal farm lands, and above all the restoration of commercial forests as an essential means to a balanced use of land and a balanced organization of rural industry. An aggressive affiliation between federal and state forest services, extension services, the Federal Farm Board, and the national and regional farm organizations would greatly speed up farm forestry.

Now there exists, ready-made, a magnificent educational machine—the Agricultural Extension Service—which can well be more largely diverted from farm crop production to forest production. Excellent progress has been made in farm forestry extension under the Clarke-McNary Act. The only question here raised is the more complete utilization of the great educational instrument available. It is no secret that farm forestry extension has been weakened by differences of opinion as to whether state foresters or agricultural extension agencies should have charge of forestry extension. Since successful extension work demands not merely a knowledge of the subject dealt with, but special training in educational methods, and since there already exists the magnificent educational machine built up by the federal and state extension services, it seems logical that this agency should be fully developed for forestry extension instead of building up duplicate machinery that would not have back of it the great momentum and the expert educational specialization of the extension service.

The development of the agricultural extension forces to meet their great opportunity in farm forestry demands, first, an increase in the supervisory force of foresters, and these foresters must be fully trained in extension methods, since their primary function is to deal with men.

Even more important is the systematic training in farm forestry of the county agents as a group. Present progress in that objective is hampered by wholly inadequate supervisory forces. It can be affirmed that not a fraction of the potential influence of county agents on farm forestry is being used. Their interest and enthusiasm must be invoked by organized training in forestry. For existing county agents, training centers similar to Forest Service ranger schools could well be established. To train future county agents, the agricultural colleges in the forested regions should establish required and elective courses in farm forestry.

A proper program of training and fully utilizing existing agricultural extension workers would bring to bear on the farm forest problem, within a year or two, several thousand trained men, equipped to deal with the human obstacles to farm forestry.

### The Untouched Field

As compared with farmers, the owners of commercial timberlands form an almost untouched field for coming to grips with better logging practices. In fact, the almost complete avoidance of this field is the inexplicable anomaly of the forestry movement. The area involved is vast, the incidence of destructive exploitation is severe, but the ownership is concentrated and organized and therefore susceptible to systematic approach by government and other agencies. In fact, a group of men who could easily be gathered into a small room could crucially affect the forest future of America. A good gambler would say that it was at least worthwhile for the government of the United States to approach these men and discuss the possibilities of doing something about destructive logging.

To develop this opportunity will require, (1) definite and continued negotiation between the government and organized forest owners and industries, (2) a systematic organized set-up to deal realistically with the immediate possibilities of forest reform, both in logging practices and in the financial and economic structure of the forest industries, and, (3) a permanent organized plan of control.

A full grasp of the urgent need and the feasibility of attacking these problems is most timely at the present moment. The National Timber Conservation Board recently appointed by the President is organized to deal chiefly with the economic problem of overproduction. The industry has asked the assistance of the government to relieve it of serious economic handicaps. This assistance should by all means be granted. In fact, only the government is strong enough to lift the lumber industry out of the morass in which it finds itself. But it is not enough that this Board shall follow the old *laissez-faire,* oblique approach of merely creating favorable economic conditions and then leaving it to the individual choice of forest owners to continue the process of devastation. No solution of this problem will be acceptable to Congress and to the public which is not based on definite, formal commitments by the leaders of the lumber industry to an organized and adequate effort to abolish destructive logging and substitute methods that will assure forest renewal.

The final article will deal with the basic principles of organized control of forest exploitation, and will appear in an early issue.

# MIRACLES

By CHARLES W. BOYCE

Many foresters of the younger generation are wondering what the "first step" is and how the various activities that demand our major attention from time to time are related to one another and to the forestry problem as a whole. Without questioning or ridiculing the desirability of forestry, the author, resorting to a trenchant style, makes some pointed criticism of our land purchase policy as an effort toward averting a possible timber famine. He believes we have failed to see our forest problem as a series of progressive steps beginning with the obvious one of making forestry a business. Building a logical foundation is too frequently neglected for following less urgent sidelines. Throughout, the author emphasizes the preëminence of fire protection.

WHEN the federal government digs down for two or three million dollars to buy as much land as can be bought for two or three million dollars, does a miracle take place? If a miracle is conjured up what does it amount to? But, perchance, if no miracle occurs, was the effort well directed and timely? Could the two or three million dollars be spent to better purpose, with greater wisdom, in some other approach to the solution of the forest problem of the United States?

We of the younger generation have listened to oft-repeated oracles of calamity. We naturally expect that they will begin to materialize, if there is truth in them. But something has gone awry; our variously predicted timber famines have not occurred; on the contrary a general, national glut of the wood markets has occurred. Some of us feel duped. The feeling is shared by many forest owners who, believing the prophecies, have failed to liquidate large investments in timberlands at any profit at all. They are disillusioned. And so are many others.

But the federal government and many states persist in believing that the prophecies were essentially right. Some slight error in time has crept in, which really makes no difference in the long run. That is all there is to it. Consequently a timber famine will occur one of these days. As one means of preventing the impending catastrophe, the federal government has undertaken the extensive purchase of forest lands; and so has a state or two. If land purchases can prevent the round-the-corner famine, miracles of a grand order must certainly occur. Since public foresters still insist on the famine theory, then the government has gone into the miracle business on a large scale.

It has never been difficult to rationalize an apurchanistic policy. Something new comes along every so often that makes fodder for propaganda and adds to the accumulation of reasons why, even adds to the very urgency of immediate action. Right now recreation distorts our perspective. Formerly, something else deluded us. But underneath there has always persisted the idea that purchases were necessary to supply timber to a wood-hungry nation.

### The Birth of Apurchanism

How do such policies originate anyway, especially old, long-suffering ones that require constant re-justification? We of the younger generation have always supposed that they grow out of conferences of weighty minds assembled in careful, analytical deliberation. Perhaps so. But it has developed that a policy good for the expenditure of at least ten millions of the public's dollars, had its foundation in the offhand statement of some one who was at the time enjoying a certain amount of leadership in the profession. Uttered possibly at an informal evening argument, the high words of wisdom were picked up, the potentate yesed, yesed and—lo, a new policy was born. Being consistent we have stuck to it. And most of us serving the same master, educated to believe the same old stories, never thought to question, perhaps never dared to question.

There is considerable doubt concerning the origin of the land purchase policy. It was among the first born of young parents whose hearts were filled with an unprecedented, an almost Christian zeal. There were giants to be slain —than which there is no better generator of zeal. How young we were! The various and illogical expatiations deepen the doubt. But it is not difficult to believe that the idea grew from a feeling that private land owners were vandals, one and all; that there was no good in them; and that all good centered in the federal government. We may admit partial truth in the former; but we cannot admit the latter. Governments are human.

But times have changed. Timber famines have not occurred and what is more the consumption of wood has decreased and even its highly touted importance in our economic and social structure and in one and a hundred other different institutional manners has lessened. Oddly enough wood is struggling for recognition in modernity; it's throne has been usurped. Most certainly times have changed! Have our policies sufficient flexibility to keep pace?

### Slaying the Wrong Giants

But first, let us assume for the moment that the timber budget of the Timber Crop Report, so persistently reiterated, is true and that our dependency upon existing timber is short lived. Growth being but a quarter or a sixth, or some other percent of our exaggerated requirements, simply cannot meet our needs when in 20, 30, 40 or 50 years all natural timber is gone. Under such conditions would it not be logical to bend every effort to grow timber quickly? How else can a national catastrophe be averted?

What would be the first logical step in growing timber in the United States; that is, the first national step? There is but one answer—fire protection. If we concentrated sufficiently upon stopping forest fires so that the average losses were brought down to the level of the average urban property losses, we would restore to forest land its full power of growth. And some 460 million acres of our 469 million acres would be growing wood every year and every day in the year.

That is, of course, recognized; it is a definite project of the federal government and the states. But for some reason before it is even half accomplished it has lost its romantic appeal; we have looked for other giants to slay. In the basic fire protection legislation we left loop holes so that we could set out upon other giant slaying campaigns if we lost interest in fire protection; we limited legislatively the extent to which the federal government should participate in fire protection.

But we have it on good authority that the new slaying sorties have not in the least hindered the federal government from participating in fire protection. But again we have it on good authority that Congress appropriates funds for fire protection under duress, and that it is now doing its best in view of the fact that it can have no property, no broad acres, to show for the money spent. And yet within the month a press release indicates that the Director of the Budget has set up priorities in considering appropriations for forestry.

Moreover, so long as the federal government's responsibilities are not fully met, it is logical to assume that the amount of money available for forestry is limited. If it isn't, then the government has met its responsibilities. But the government itself admits a bit more remains to be done. Obviously blocking out two or three million dollars a year for land purchases robs other projects.

### Spending Uncle Sam's Millions

It is fair to speculate upon what does happen when the federal government buys land. Supposing a million acres are bought; how does the purchase affect the general forestry situation in the country and what does it contribute to solving the forestry problem?

Many labor under the officially reiterated idea that all land should be used, i. e., it should be "put to work," i. e., it should grow timber. Mere governmental purchase does nothing toward accomplishing any of these purposes; subsequent appropriations are needed. In other words, no miracle occurs when land is purchased by the government. On the contrary, the slow process of forest growth continues as if nothing had happened. Nothing changes; not a leaf trembles in awe at the mighty transition.

The Government must set things right. What is the first step it takes in putting this land "to work"? Obviously, it puts in a system of fire protection. The second step or steps either do or do not follow; at any rate not a great deal happens.

### Forehanded Uncle Sam!

If there is no timber on the million acres that we have just purchased for the federal government, there is vague talk of planting, for this land *must* be put to work. In the recent mobilization of the Congressional army a bill was passed which gave impetus to the planting program on the national forests. As a matter of fact, the passage of this bill may permit the planting of as many as 40,000 acres a year. With such a program the yearly purchase of a million acres to plant is somewhat forehanded, to say the least. If the nation needs the

production of all forest land, the present planting attack faintly resembles a flea stalking an elephant with murder in his heart.

What happens to the neglected acres, those that are not planted? Given fire protection a surprising amount of wood grows on them. In spite of their purchase they are "put to work" in quite a God-given way. The growth may not be suitable for uppers, selects, veneer logs, or masts for the royal navy, but it will be very acceptable for whatever industry happens to be near enough to use it. This is the miracle, for no one expects any growth at all. So we buy more land to plant!

Moreover it is a trifle difficult to see how planting 40,000 acres a year can do much to control erosion within at least a thousand years, or how it can provide very much more shadow for city picnickers, or how it can prevent the too rapid melting of the winter snows in the country as a whole. These things involve millions and millions, then a hundred million more acres of land. It probably makes little difference whether the forest cover is a tightly packed plantation of white pine or Indo-China ginkoes or a natural covering of snow brush or jack pine intermingled with some other species that we look upon with greater favor. As a matter of fact the lusty brush does the trick more quickly—and it will grow on millions of acres all at once. If it were not for the brush, the most dire prophesies would probably take place in one, two, three order; and all would be oblivion. Thank the Lord for brush!

Simmering all these things down to essences, the benefit of purchase seems to lie in the fact that the government can protect from fire the lands that it owns. It is not proven, however, that it can not protect lands that it does not own. We assume that it can, in view of the Clarke-McNary preamble. But the contingencies of that law are such, and the will, or may we say the under-scattered-pressure response of Congress is such that the federal power is limited. And so instead of changing the law, a more expensive, a more roundabout method is adopted; land is purchased in wholesale lots. In the meanwhile a third of our total forest area, much of it the best growing land in the country, is subject to repeated fire damage, and no forest property is protected sufficiently to be insurable at reasonable rates. Strange vagaries, these of our public mind!

## No, the Government Does Not Compete

It has been variously claimed that the government does not compete with private owners of land in the production of timber. At the same time the federal government buys land so that it can assure to the public a plentiful supply of wood, so vitally essential that any stringency is wholly unthinkable. If the federal government miracles the plentiful supply, how can it be in competition with private owners! No, as a matter of fact, it eliminates all competition and those private owners who are trying to build up an economic advantage in timber control, are doing business when they have no business. It is indeed fortunate that the public does not have to rack its collective brain to

rationalize these things; just a part of the public has to, the part that owns forest land. This part is doing the only thing it can do; it is waiting. Surely the competition is there, whether it is called "supplementing" the private effort or not. With the forest growth on a hundred million acres of land, the federal effort to "supplement" the efforts of private owners is and will continue to be enough to discourage most owners from doing anything themselves.

Frequently one wonders what the progressive lumberman or pulp manufacturer in Louisiana thought when the federal government dropped a national forest beside him. If he were at all logical and a business man, would he not just naturally skin his lands and purchase from the benevolent government when the skinning process was completed? Again one wonders what will happen in the Lake States when the present recreation craze has subsided and conditions change so that private efforts can really accomplish something in forestry. With two or three million acres purchased and presumably growing timber under governmental auspices, would it not be good sense for the private owner to get out?

If we really thought about the situation a great deal it would be not at all difficult to raise a number of embarrassing questions and considerable doubt as to whether we know enough to permit any governmental bureau to cruise about looking for what it may purchase. As a matter of fact we started to slay a giant before the giant's birth. Surely it would be wisdom to wait awhile to see what does happen. Meanwhile we could do the obvious thing that underlies any policy—stop fires.

### There, There, Children

It is likely that the balance between consumption and supplies of timber in the United States will take place at a much lower figure than has been anticipated, probably not far from ten billion cubic feet a year. Governmental policies are based upon a consumption of at least twenty-five billion cubic feet and one that is continually growing from that level. A check of present consumption trends show that our actual consumption is now probably around 16 billion cubic feet. Something is wrong with the picture. Can it be the federal government?

By a There-there-children-you-must-have-faith-in-wood, we are admonished. But we have faith. We can see wood filling a larger and larger part in the economic structure of the United States; but we cannot see this happening until the raw materials with which wood competes, metals, stones, clays, etc., increase in price. Modern industrialization has made cheap the utilization of these materials. At the same time civilization has changed from the pioneer to the permanent type. High speed has become a mania to which wood is not well adapted, airplanes to the contrary. In fact, a totally impartial analysis of the situation really shows that wood itself has been substituted for iron, brick, cement, etc., for untold ages—ages before these things were even thought of. Instead of mourning the drop in consumption of wood it would be more becoming if we rejoiced in the fact that we

did have a profitable opportunity to realize upon our virgin forests, or most of them. The There-there-children attitude not only dodges facts but it approaches willful misleading.

Indeed there is considerable reason to believe that all our idle acres do not need to be "put to work." In case of the slightest doubt, it is somewhat absurd to spend millions of dollars simply to prove that we have a faith in wood. It would seem to be very much more sensible and American to wait until we knew or had reason to know what was going to happen and what was the part of the federal government in the whole program before we add to its oily grassy, woody property burdens. After all the United States will probably exist for some time to come and there will be people in it. Present conditions will change slowly, very slowly. There actually is time enough to act with real wisdom.

## Round or Square National Forests

In the meantime much land is reverting for non-payment of taxes. The sum total of land reversions is staggering; exceeding by far the area that the federal government itself can afford to purchase. Of course, tax reverted land does not become the property of the federal government. It does not seem impossible however to arrange means for transferring it without cost from state to federal government ownership if the latter wants it and the state does not. Such transfers might satisfy the federal government's hunger for land.

Well-blocked national forests, however, do not revert all at once. The reversion of a forty here and a quarter section there is not conducive to a type of administration and management which has for its purpose the "putting of idle acres to work." We shouldn't worry about that, however, if we have adequate and universal protection from fire.

Moreover considerable doubt exists as to the feasibility of putting such lands to work until there is a well-defined and actual need for the timber they can produce. This applies to poor, submarginal lands as well. In the meantime the better and more accessible lands, chiefly in private ownership, could be used for forestry purpose in a purely business way. After a century or two or three it might be found that enough land had reverted to make nice round or square national forests. Even if it were found that some purchases were necessary to make them round or square, it is safe to say that the acreage needed would not be extensive. And if, on the other hand, we found that the government's function in growing timber was to equalize supply and demand using the lands it already has, a lot of money could be saved.

And so the argument can go on. Every year Congress is attacked by the apurchanistically-minded gentry. And Congress yields a little bit. In doing so the afore-mentioned gentlemen are encouraged to make grander attacks. And so it goes—gorgeous evidence of insistent public demand; gorgeous evidence, too, of our lack of getting down to brass tacks in our forestry thought. We have failed to see our forest problem as a series of progressive steps, which begin with the most obvious, those which will

make forestry a business. Impatience has led us off on tangents, has led us to attempt the accomplishment of measures that are, to be sure, part of the problem, but that are far from being an urgent part of the fundamental groundwork demanded not only for business forestry but also for public interest forestry. It is our job to do those things which are up to our generation to do, i. e., to lay the groundwork. We can safely leave to future generations the jobs that are actually theirs. Moreover none can prophesize what future needs will be.

Had we adopted this plan from the beginning, we could have concentrated upon Congress the various and sundry pressures of the Podunk Community builders, the Metropolitan Shade hunters, the Walton League fish teasers, the Sportsmen deer molesters, and the Erosion Pessimists, and undoubtedly the fire protection problem would have been solved by this time. It is not too late to concentrate our efforts even now. But to do so we must stop random pot shooting and all of us get together to stalk the same game.

And would it not be well to begin such a program by revamping the Clarke-McNary law to enable the federal government to get at the fire problem? We know now that we cannot insure property at reasonable rates when the funds for protection depend upon private contributions. Protection is, therefore, a public function, wholly and irrevocably. We have already outdated the original Clarke-McNary Act. Surely, we can revise it without risking our good name for consistency. In fact, we could do it without going back on anything we have said; we can simply shift the emphasis.

In the meanwhile, it would be a much better sporting proposition to let some of the other giants grow to full size before we assail them. We could have much more fun, say in 2030 A. D. Then we should know at least what we are about and what is needed. Then perhaps a grand system of national and state forests may be needed. Perhaps they should be on good land or on poor land or on a mixture. Right now we can not see clearly into the future; but we do know that whatever direction we take, adequate protection from fire is the starting point.

The miracle-making role of the public consists in the last analysis in paving the way for the well-known and traditionally accepted miracles of nature, which is, in fact, not miracle-making but good governing. And like the mariners in the Last Chanty, those who own land cry to the powers that govern for an equitable, free, business chance to do their stuff. Why should they be denied?

# REVIEWS

**A New System of Planting.** By M. L. Anderson. *The Scottish Forestry Journal, Vol. 44, Part 2, pp. 78-87, October, 1930.*

It is like a breath of fresh air to read an article such as Anderson's with its radical proposal. We know that the general rule in forest planting in Europe has been to space the trees closely for the sake of producing first class timber. The tendency for economy's sake has been to increase the planting distance. In the United States a common spacing has been six feet by six feet and somewhat wider under certain conditions, both physical and economic. Close spacing admittedly produces trees of better form and quality if the planted forest is subsequently given early thinnings. The general tendency has been to plant with one species and to give the trees relatively wide spacing for economy's sake. This is likely to be accentuated by unfilled blanks caused by death of individuals after planting.

Gevorkiantz ad Hosley[1] have admirably shown the development of white pine in pure stands and have stated that owing to the effect of weevil injury and of persistent dead branches on quality that white pine should be grown in dense stands in early years. In respect to plantations spaced six feet by six feet and wider they make this comment, "Perhaps the initial cost of planting was low, but it is quite evident now that the final value of the lumber will also be low, making a final profit questionable." No doubt we shall decide differently with regard to the spacing of the different species now being used in reforestation because of their individual characteristics with respect to crown and stem development and the particular product which is desired. Nevertheless, plantations now being set will be productive at a time when, I surmise, there will be much low grade competitive material from natural stands. A present objective, therefore, of producing high grade material is more sound than the hypothesis that wood material of any grade will be much sought after.

How to attain this objective economically, that is profitably, is an important problem. Anderson strikes boldly out along this line in a new proposal of group planting with gaps between groups. He says, "that the best way of economizing is not to increase the planting distance from 3 feet to 6 feet or more . . . . but simply to increase the average planting distance by an equivalent amount and to achieve this by instituting a method of planting in dense groups." The spacing of trees in the groups may be as close as two or

[1]Form and Development of White Pine stands in relation to growing space. S. R. Gevorkiantz and N. W. Hosley, Bul. No. 13, Harvard Forest, Petersham, Mass. 1929.

three feet, but the large gaps between groups are not planted at all. He suggests experimenting to determine number per group, the form of the group, spacing within groups and spacing between groups.

The proposal is an elaboration of an article by Anderson and Kay in the *Empire Forestry Journal*, Vol. 7, No. 1 in 1928 on Douglas fir, in which the theory was enunciated. The basis was their statement which is again quoted here:

"In comparison with natural stands, therefore, the more open, regular spacing of plantations in early youth tends to a production of more crooked, twisted and heavily-branched stems of faster growth. Later on, the growth in height and girth of individual trees is more even, while the canopy forms at a uniform height and in an unbroken layer, so that the resultant crop is actually weaker than in the natural stand, which consists of a collection of compact, self-contained groups."

The number of stems in the final crop determines the number of groups, apparently the objective being to develop a minimum of one good quality timber tree per group in which the number of individuals and spacing will favor cleanness of stem and good form. He illustrates as follows: "Some idea of the possible number of trees per group can be obtained by considering the specific case of Scots pine on poor ground, where the minimum spacing in general use today is 4 feet by 4 feet. This corresponds to 2722 trees per acre. If we plant 7 trees per group we could have 389 groups; if 9 trees per group, 303 groups; if 13 trees per group, 209 groups; and with 18 trees per group, 151 groups, without increasing the cost of plants required per acre. On poor quality ground it is clear that 150 stems in the final crop is somewhat low for Scots pine, so that 18 would probably be the maximum number of trees per group in this instance." Taking 21 trees as the maximum number he shows, in Figure 1, a diagram of group structure:

Under their current practice of a spacing of 5 feet by 5 feet for species other than pine and 6 feet by 6 feet for larch and Douglas fir, he indicates 13 or 16 trees per group to be suitable if no more plants per acre are to be used than in present practice. Since this touches the spacing in plantations in North America, table I will be of interest.

The spacing within groups will necessarily be a matter of experiment according to Anderson who suggests 3.5 feet

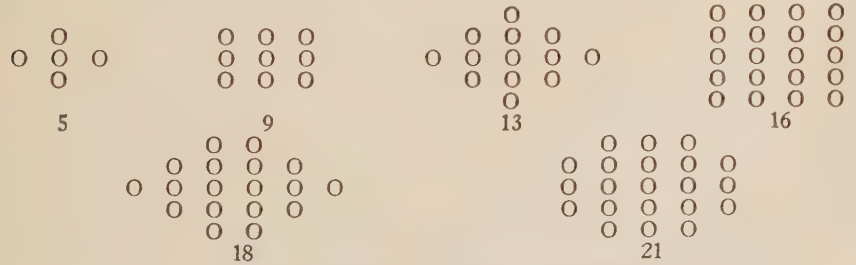


FIG. 1.—DIAGRAM OF GROUP STRUCTURES

TABLE I

GROUP-SPACING IN RELATION TO PLANTING DISTANCE

(13-tree Groups)

| Planting distance by present system Feet | Stems Per acre | No. of groups per acre New system | Spacing between group-centres Feet |
|---|---|---|---|
| 4 by 4 | 2722 | 209 | 14 by 14 (approx.) |
| 4.5 by 4.5 | 2150 | 165 | 16 by 16 (approx.) |
| 5 by 5 | 1742 | 134 | 18 by 18 (approx.) |
| 5.5 by 5.5 | 1440 | 111 | 20 by 20 (approx.) |
| 6 by 6 | 1210 | 93 | 21.5 by 21.5 (approx.) |

by 3.5 feet for Douglas fir. He develops in another table various considerations regarding intervals within groups and outside between groups as well as showing the application in mixed planting.

With much detail the author of this new proposal goes into the probable advantages and disadvantages. In the former he recognizes the production of clean stems with small branches, greater stability against storm damage of groups and of the whole stand, easier to treat and manage, the quick death of vegetation beneath groups, but less tendency to over-accumulate raw humus because of the presence of open spaces between groups, less intensive preliminary treatment of planted areas, easier to weed, produces game coverts in early period of growth, may permit grazing to reduce cover in open areas, does not increase cost, is adaptable to rough ground, and a few other minor advantages. Of the disadvantages Anderson recognizes the problem of organization of planting, the lower grade of material in the outer trees of groups eventually to be removed in thinning and the real danger of trees on the edges of groups suppressing inner trees. He feels that although it is a compromise between wide and close spacing methods, it has advantages which neither provides.

On the whole I believe the method is well worth trial in this country in the South, in the mountain national forests and in planting land sub-marginal for agriculture, which is open or brushy. In the last instance small game coverts are especially useful and correlated with the requirements of game birds, it should prove useful at least in a part of abandoned land planting.

S. N. SPRING,
*Cornell University.*

**Qualitatsbestimmung des Schleif- und Celluloseholzes (Quality Evaluation of Wood for Mechanical and Chemical Pulp.)** By Gustav G. Klem. *Published in "Der Papier-Fabrikant", Vol. 28, No. 31, pp. 489-494; No. 32, pp. 501-508; and No. 33, pp. 521-524, Berlin. 1930.*

In this paper, presented before the Norwegian Paper Industry in Oslo, the author points out that the width of the annual ring is not reliable for judging the specific gravity of wood, especially when the wood originates in different

regions or in different stands with unlike conditions of growth; that the summerwood zone in a growth ring largely determines its specific gravity and that the specific gravity of the wood has an important influence upon the yield of paper obtained per cubic unit. The practical difficulties in using the width of the annual ring as a standard for measuring wood quality are emphasized.

The results of an investigation of 481 spruce trees from seven different localities are employed to show the feasibility of using tree taper or tree form as a measure of wood quality.

The trees were divided into groups. Curves, showing the relation between specific gravity and taper and between knottiness and taper, are presented for each group separately and finally for all of the trees taken together. A consistent relationship is shown in all of the graphs.

Taper measurements taken on the upper and lower portions of the tree stems gave similar results, but the limits of taper in the upper portions of the trees were much narrower.

Curves based upon the form quotient of the trees instead of taper followed the same trends in relation to the specific gravity and to the knottiness of the trees. With the exception that above a form quotient of 0.70 the specific gravity of the wood failed to increase with a higher form quotient. This is attributed to slow growth in over-stocked stands resulting in wood of lighter weight. A decrease in the form quotient from 0.70 to 0.50 was accompanied by a decrease of over 20 per cent in the specific gravity of the wood.

Finally, curves are presented to show how the quality of the wood may be judged on a basis of the total height and diameter of the trees. Trees of the same height of different diameters are used for each curve. For example, consider trees all of which were 12 meters in height, the trees 15 centimeters in diameter had an average specific gravity of 0.50, the trees 18 centimeters in diameter an average specific gravity of 0.445, and the trees 24 centimeters in diameter an average specific gravity of only 0.39. A similar relation was found to hold good with respect to the knottiness of the trees.

The author places great emphasis on the claim that raw pulp wood should be paid for according to its value for the manufacture of paper instead of paying the same price for wood which is of high quality as is paid for wood of low quality. He states that in the poorer classes of wood as high as 15 to 20 per cent of the wood is lost in the removal of knots, etc. He shows that the form of the tree is determined by its growing space in the forest and that the trees with better form stand in the more thickly-stocked areas. He stresses the importance to forest management of establishing limits of stocking in order to obtain the best wood qualitatively for different uses.

Among the advantages pointed out in the adoption of a quality standard for pulp wood is the incentive of the forest owner to grow good wood. Under existing conditions there is no incentive for the production of wood of high quality since wood of high and low quality are paid for at the same rate. The adoption of a quality standard he

says will have a favorable influence on the pulp and paper industry as well as upon silviculture.

BENSON H. PAUL,
*U. S. Forest Products Laboratory.*

**Du gui ("On Mistletoe").** By J. Péter-Contesse, *Journ. For. Suisse. Vol. 81:217-223, 247-258. Oct. and Nov. 1930.* (*Illustrations.*)

That extraordinary group of phanerogamous parasites, the mistletoes, is represented in Europe, north of the Alps, by *Viscum labum,* a close relative of our American Phoradendron. Of the latter we have many species, mostly confined to broad-leaved trees though some are restricted to coniferous hosts, such as firs and certain Cupressineae. *Viscum album* is the only representative of the genus in northern Europe, but it is split into three races or varieties, one on broad-leaved trees, one on firs and one on pines. The first of these appears rather rarely in the forest but is common and injurious on park, shade and orchard trees. It is extremely rare on oak, one of the favorite hosts of our Phoradendron. The forester will be more interested in the fir and pine races.

The taxonomy, anatomy and physiology of the European mistletoe have found classical treatment in Tubeuf's work "*Monographie der Mistel*" but as to the damage caused to the individual trees and to the forest as a whole practically nothing is known beyond the undoubted fact that it is great. To fill this gap Péter-Contesse contributes a study on the fir race in Switzerland, those on the broad-leaved trees and on pine being either without importance or absent in that country. He comes to the following conclusions:

The injury takes on many forms and is extremely variable, according to the reactions set up by each individual fir. The greatest damage occurs on hosts growing on soils of low fertility. As to its character Péter-Contesse brings out the curious relation that the hypertrophy of the host at the point of infection is, in general, rather weak when the aërial part of the mistletoe is well developed. It is much greater when the mistletoe is reduced to the roots and adventive buds imbedded in the host tissues. Furthermore, his observations indicate that, in contrast to the general rule, there is in the mistletoe no direct relation between the development of the root system and that of the aërial parts. In mistletoe the reduction or disappearance of the aërial part stimulates growth of the root system. Such reduced plants are frequent in infections of the stem and the resulting swellings may be, and often are, pronounced. In one case, that of a fir with a basal diameter of 20 inches, the stem measured 16 inches at a height of 26.5 feet. At 30 feet the diameter increased abruptly to 32 inches.

Infections of the upper part of the stem not merely retard but actually stop growth in height. The trees remain stunted and the crown becomes bunchy and top heavy. The greatest loss, from the forester's standpoint, comes from the decline of the increment which in badly infected trees frequently decreases to the vanishing point. Péter-Contesse gives

an interesting explanation for this effect. He seeks the cause in the fact that the growth period of the parasite does not coincide with that of the host. The mistletoe begins its growth at the end of winter and in early spring about February, when the fir is still fully dormant. In order to provide for its growth activities the mistletoe probably draws heavily on the reserve foods of the host, and the latter is drained of the material it had accumulated in the preceding year against the demands arising with the resumption of its own spring growth. In the long run the affected firs become more and more weakened and fall a ready prey to the attacks of other pests, among which Bostrichus stands in the first rank.

The quality of the wood actually invaded by the roots of the parasite is seriously impaired. The wood is brittle and irregular in structure, useless for lumber and not even good for fuel. The bark thickens abnormally. It often cracks open and furnishes an easy entrance to wood-decaying fungi.

Péter-Contesse does not attempt to evaluate the loss accruing from mistletoe in the forest in actual figures, but he does show that it frequently is a very heavy one. The value of his paper to American foresters lies in the fact that practically all he has said applies with little modification to our own Phoradendron and even to that other and far more important representative of the Loranthaceae, Razoumofskya or lesser mistletoe which causes a truly enormous loss in many of our coniferous species. In Europe this latter genus appears only in the South and is of little consequence. It has relatively little importance in the eastern United States, but the entire West is overrun with it and its drain on the yield of western yellow and Jeffrey pine, of the white pines, lodgepole pine, larch, hemlock, Douglas fir and true firs is beyond computation. Its action is not conspicuous. No spectacular killing accompanies its presence. Partly for this reason, partly in realization of the enormity of the task of a possible control mistletoe in western coniferous forests is taken for granted like poor sites, droughts and excessive rainfall.

What is badly needed is a series of thoroughgoing analyses of the damage caused both by Phoradendron and Razoumofskya in this country. We want to know more of their life history. Serious thought should be given to the difficult problem of control in the forest. So far only a beginning has been made.

E. P. MEINECKE,
*In charge, Research Planting,*
*Bureau of Plant Industry,*
*San Francisco, Calif.*

**Frost Heaving.** By Stephen Taber *Journal of Geology, volume 37, pages 428-461, 1929.*

**The Mechanics of Frost Heaving.** By Stephen Taber. *Journal of Geology, volume 38, pages 303-317, 1930.*

**Freezing and Thawing of Soils as Factors in the Destruction of**

**Road Pavements.** By Stephen Taber. *Public Roads, volume 11, pages 113-132, 1930.*

These three papers present ideas of interest to both silviculturists and those foresters who are concerned with road construction.

Recalling the reports of several observers that the amount of heaving is sometimes greater than can be accounted for merely by the expansion of the water in the soil, Doctor Taber presents a theory to account for this phenomenon. His suggestion is that the large-scale heaving (the uplift in some cases being as great as three-fifths of the depth of freezing) is due to the growth of ice crystals from below, successive increments of water being withdrawn by freezing from the top of a column. Just as water is removed by evaporation from the minute menisci at the tops of the columns in trees and additional water is brought up to the surface film apparently by virtue of the cohesive properties of water when placed under tension,[1] so additional water is brought up to the bottom of the newly-formed ice. With the freezing of each successive layer of water, perhaps only one molecule in thickness, the entire block of overlying ice is moved upwards by the well-known 10-per-cent expansion of water accompanying the change from the liquid to the solid state.

A number of years ago, Hilgard[2] offered a somewhat simliar explanation for the formation of ribbon-like structures of ice in certain soils. The present reviewer, also, on the basis of some observations in northern Arizona,[3] surmised that the superficial layer of ice in soils increased in thickness by successive additions of ice to the bottom. An attempt was made to measure the thickness of these layers and the conclusion was reached that they were at least from 0.05 to 0.30 of an inch in thickness, but possibly much thinner. If Taber's theory is to be accepted, the thickness of each successive layer is of course far less than the figures just given. Presumably the building up of ice layers which have been observed on the outside of porous-porcelain atmometer spheres[4] is effected in a similar way.

In view of what is known of liquid tension, Taber's concept that additional water is brought up to the ice in a continuous column with the water under tension appears to offer a satisfactory explanation of the mechanics involved. It is, however, worth while to keep in mind two other possible explanations which have been advanced to account for at least part of the movement of water toward the base of the nascent ice layer.

Hilgard (p. 210-211) thought of distillation as a means of transfer of water

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[1]For a discussion of liquid tension, see, for example, the following:
Dixon, H. H. Transpiration and the ascent of sap in plants, London, 1914, Ch. IV and V; Palladin, Volume I. (Livingston, B. E., ed.) Plant Physiology, 3d Amer. ed., Philadelphia, 1926, p. 147-150.

[2]Hilgard, E. W. Soils, 1907, (p. 119).

[3]Haasis, F. W. Frost heaving of western yellow pine seedlings. Ecology, Vol. 4; pages 378-390, 1923.

[4]Livingston, B. E., and Haasis, F. W. The measurement of evaporation in freezing weather. Journal of Ecology, Vol. 17, pages 315-328. 1929.

from the subsoil to the upper soil layers. The reviewer, in his article, has suggested that diffusion plays a large part in the transfer of water from the deeper soil layers. This supposition is predicated on an increased concentration of the soil solution resultant from the forcing out of contained salts as each successive layer of water freezes.

Taber lists the following as the chief factors controlling ice segregation: size of soil particle, amount of water available, size and percentage of voids, rate of cooling, and surface load. He gives the following summary of his concept of the mechanics of frost heaving, to which his studies have led him, aptly suggesting that it may seem paradoxical to those whose knowledge of the phenomenon is based on experiments with closed systems: "(1) Heaving on clay is greater than on sand, although part of the water does not freeze in clays, whereas practically all of it, within the zone of frost penetration, freezes in sand. (2) The pressure developed during heaving in an open system is limited by the tensile stress that can be developed in the water. (3) The boiling-point of a liquid seems to be more important than the freezing-point in determining the pressure developed by freezing in open systems. (4) While water expands on freezing, the freezing of saturated clays may be accompanied by the formation of shrinkage cracks, owing to withdrawal of water to build ice layers. (5) Heaving is upward because that is the direction of heat conduction rather than because it is the direction of least resistance."

Several suggestions, referring particularly to highway work, are offered by the author as means of mitigating the damage caused by the freezing, thawing, or alternate freezing and thawing of soils: "Proper drainage is always essential. Placing a thick layer of coarse material under the pavement, extending to the extreme depth of ground freezing, is an effective but expensive method. Addition of sand to the subgrade will prevent ice segregation. Uniformity of texture in subgrade soils is essential to the avoidance of differential heaving."

The studies whose results are described in these papers were conducted in the laboratory with somewhat elaborate low-temperature apparatus. Several different kinds of material were experimented with, such as sand, clay, quartz dust, and barium sulfate. For the most part the freezing was done in water-proofed cardboard containers which could easily be removed for study and photographing of the frozen soils.

A feature of each of these papers well worthy of adoption by all contributors to scientific periodicals is a brief abstract placed between the title and the introduction.

FERDINAND W. HAASIS,
*Carnegie Institution of Washington, Carmel, Calif.*

**Reforestation by Private Enterprise.** By F. G. Wilson. *Circular 239, Agricultural Experiment Station, University of Wisconsin, 1930.*

According to this circular, the total investment in the wood-using industries in Wisconsin amounts to about $255,-

000,000. These industries pay one-fourth of the taxes levied in the state. They distribute, in the form of salaries and wages, about $55,000,000 per year. In the wood pulp and paper industry alone there is invested about $130,000,000.

The stand of merchantable timber within the state available to the sawmills will last them, at the 1928 rate of cutting, only about ten years. The supply of merchantable spruce pulpwood available to the paper mills will last them only a very short time. The supply of jack pine and hemlock pulpwood seems quite adequate to the present requirements of the paper mills, but much of it is so located that it is expensive to deliver at the mills.

The purpose of this circular is to show that it is now feasible for private owners, especially paper companies, to engage in extensive reforestation projects. It is stated that one paper company has planted level sandy lands with two-year old seedlings at a total cost of slightly less than $5.00 per acre. The same company has planted heavy stony land at a cost of $5.70 per acre. The reforestation routine followed by this company is given in detail.

Volume yield tables for fully stocked stands of jack pine, second growth white spruce, second growth white pine, and for well stocked stands of Norway pine are included. There is also a table showing the cost of production per cord for jack pine on "good", "medium", and "poor" sites. This table is based upon certain definite assumptions with regard to the cost of establishing the crop, the cost protection, etc.

The reviewer feels that certain of the points made in this circular are open to question, namely; is Wisconsin "the most advanced state in the field of forest taxation"? From a fundamental point of view, the Oregon forest tax law is a better one than Wisconsin's.

Are the production costs, as calculated, reasonable? These costs as given in Table V, page 37, are based upon the yield of fully-stocked stands. Should not such costs be based upon the probable yield of extensive stands as we will probably find them rather than upon the yield of fully stocked stands? German experience indicates that the ordinary forest under good management will produce not more than 70 per cent of the volume given by the yield table for a fully stocked stand. Also should not the costs of production be farther increased by proper allowances to cover such items as overhead, fire, insect and drought hazard, etc.?

Mixed in alternate rows, is it safer to plant Norway and white pine together than Norway and jack pine? The reviewer doubts this statement. With stands up to 15 years of age, his experience has been that Norway pine can take care of itself in jack-Norway pine alternate row mixtures, at least upon the poorer, drier soils.

On page 12, survival percentages are given for several species of conifers, but the age to which these percentages apply is not indicated. Should not the age, or ages, pertaining to these figures be given?

On page 19 there seems to be an error in the use of the terms "acre" and

"cord" with reference to costs and values.

While containing much information of value, it seems to the reviewer that this Circular devotes relatively altogether too much space to jack pine and much too little to spruce and other species. According to the information given at the beginning of the circular, it is spruce pulpwood that the Wisconsin paper mills are really short of.

J. H. Allison,
*University of Minnesota.*

**The Evolution of Soils as Affected by the Old Field White Pine—Mixed Hardwood Succession in Central New England.** By B. G. Griffith, E. W. Hartwell, and T. E. Shaw. *Harvard Forest, Bulletin 15, Petersham, Mass., pp. 82, 7 figures, 17 tables. 1930.*

For the past decade many foresters in New England have seriously doubted the wisdom of the wide-spread practice of planting extensive pure stands of northern white pine on the heavy upland soils. The depredations by the white pine blister rust and the white pine weevil in many of these plantations plus the attendant cost of protective measures have justified this apprehension. Now an additional argument is presented against this "white pine complex." In one of the most important contributions to our knowledge of American forest soils the warning is clearly set forth that the danger of such an unbalanced silvicultural practice is not confined wholly to the timber crop, but what is more important, *a serious and lasting degeneration of the soil takes place.*

As Professor Fisher states in the introduction to this bulletin "The chronology of the whole succession to which the present observations apply may be summed up as follows: an indeterminate past of mixed virgin forest, a hundred years of pasture and tillage, eighty years of pure white pine, and forty years of mixed hardwoods." In order to trace differences in the soil development under the last two phases of succession, profile studies were made on pure pine plots having an age range from ten to eighty years and on mixed hardwood plots five to forty years old. Although the profiles were located on three soil series (Gloucester, Charlton, and Brookfield), analysis proved that these were sufficiently alike to be comparable, so that all plots of the same floristic composition could be averaged together. No plots on sandy soils were included in the compilations. The plots varied in size from one quarter acre for merchantable timber, to one hundreth acre for the youngest trees. On each plot three profile holes were dug down to mineral soil. These served both as a source of data on physical conditions and for securing soil samples of the different horizons for laboratory tests. Totals of 187 and 164 profiles were made in pure pine and succeeding mixed hardwood stands respectively. In addition 54 profiles were taken under a virgin white pine-hemlock forest, and 21 under old hardwood stands which did not originate on cut-over pine land. In the laboratory the following determina-

tions were made: 1. Texture, for the purpose of soil classification, by the Bouyoucos hydrometer method; 2. Organic matter, by ignition loss; 3. Hydrogen-ion concentration and buffer content, by the quinhydrone method of Snyder; and 4. Nitrogen, using the standard Kjedahl method.

The dissimilarity in soil development under pine and succeeding mixed hardwoods was found to be readily discernible through a study of the various horizons of the soil profiles. Under the old-field white pine type with its rather uniformly cool temperature and low radiation, four distinct and sharply defined horizons are generally present. First, there is an organic layer of considerable thickness composed chiefly of felted needles in an arrested stage of decomposition. Next comes the leached or podsol horizon from which the profile derives its name. This is a layer from which the organic matter and colloids are extracted by the action of water and of the organic acids produced above by the slow decomposition. The enriched horizon, dark brown to light brown in color, which follows is the layer in which the leached materials from above are redeposited. Finally, there is the mineral horizon composed of weathered materials which have not been enriched by substances from above.

Beneath the succeeding hardwood stands where there is a wide annual range in climatic action, a typical mull profile is found. The leached layer is absent. Here the thick, dense, organic horizon of the podsol profile has been reduced to a narrow band, which in some cases may be entirely lacking, and the enriched horizon has greatly increased in depth. It is a generally accepted fact that soil degeneration is taking place where podsolization occurs south of the climatic zone which engenders it. Under pure pine in central New England traces of leaching can be found when the stand is forty years old; by the time the trees are eighty years of age the leached zone may be well defined. Such distinctly podsolized soils can be altered favorably in twenty years to a typical mull or brown earth by the mixed hardwoods stands following the cutting of the pine. In the region in question mixed stands are relatively easy to develop on cut-over lands, while pure pine is often attainable only through costly weedings and release cuttings. Furthermore, such pure stands are subject to many ailments. The mixed stands should be favored, therefore, not only from silvicultural[1] and protection[2] standpoints, but also because of their soil sanitation value.

The laboratory tests made with soil samples from the different horizons of podsol and mull profiles elucidate some of the technical differences in these soils. On a weight basis only slight differences were found in the percentages of either inorganic or organic colloids in the enriched horizons of the two profiles. More significant and important, however, is the change in depth of the organic and enriched horizons accompany-

[1]Mixed pine and hardwoods—A. C. Cline and C. R. Lockard, Bulletin 8, Harvard Forest. 1925.

[2]The white pine weevil: its biology and control—H. J. MacAloney, Technical Publication 28, New York State College of Forestry. 1930.

ing the transition to hardwoods. Thus, under ten-year-old hardwoods following pine, there was found to be a sixty per cent disintegration of the pine organic layers. The product of horizon depth and percentage of organic matter of the dark brown zone are 33 and 49 for pine and ten-year-old hardwoods respectively, or almost a fifty per cent increase in favor of the hardwoods. This increase in organic matter reflects a direct increase in consistency, flocculation, and tilth, and subsequently an increase in soil aeration, ease of root penetration, and equalization of moisture content. A slight increase in acidity was found to exist with increase in age of the pine stands (from pH 5.1-4.2 to pH 4.6-3.3). The hardwoods following the pine did not change the soil reaction appreciably in forty years. The buffer curves of pine and hardwoods did not vary materially. After the establishment of the latter stands, however, there was found to be a narrowing of the organic matter nitrogen ratio and an increase in the total nitrogen. This indicates a more rapid metabolism of the soil micro örganisms and a more complete breaking down of the organic matter.

In the conclusion which Doctor Gast has prepared for this bulletin he states—"that in respect to soil qualities the effects of a pure pine stand as contrasted with those of mixed hardwoods are comparable to the effects of poor farming and good farming." To this relevant statement the reviewer wishes to add: Will the facts presented in this timely publication be taken into account in the extensive planting programs in the Northeast or must we learn through bitter and costly experience what the Saxon foresters[3] have learned from their one-sided silvicultural policy of clear-cutting and planting pure spruce stands?

PAUL W. STICKEL,
*Northeastern Forest Experiment Station.*

Attention is called to "Skeleton Planting" by Earle Stafford, Journal of Forestry, Jan., 1931, for other comments on pure planting. *Ed.*

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**Om Skogsjordsanalyser. (Regarding analysis of forest soils.)** By Olof Tamm. *Meddelanden fran Statens Skogsforsoksanstalt. Sweden. (Reports of the Swedish Institute of Experimental Forestry.) Vol. 13-14, p. 235-460, 1 fig., 6 tables. 1916-1917.*

In reviewing the history of soil analysis the author states that because of Liebig's original theories the problems regarding the content of different substances in the soil became very critical, and it would be expected that chemical analysis could give an exact expression for the value of the soil and its need of fertilization. These expectations, however, did not come true, mainly due to the fact that the crop is influenced by so many factors other than the content of easily dissolvable nutritive substances.

In Scandinavia and Germany investigations were carried out by Meyer, Schüke, Müller, Tuxen, Ramann, Tiberz,

[3]Observations on results of artificial forestry in Germany—Anonymous. Journal of Forestry, 21:718-22. 1923.

Schoenberz, Vogel von Falskenstein and others.

Some of these men considered it most important to remove all lime and therefore used the HCl method. Vogel von Falskenstein employed acetic acid. Müller and Tuxen discussed the influence from soil-building factors, characteristics in the soil profile, the relation between plant and animal life. They, therefore, recommended a study of all factors important to produce forests besides the soil-analysis.

At the time of the international agro-geological conference in Stockholm, 1910, opinions about and methods for analysis were many and different. From the discussions in this and from other published works it seems, however, to be evident that it is not possible to find out the value of a soil for production only by means of chemical analysis because these only can give an idea about some of the characteristics of the soil for producing forests.

With consideration for these viewpoints and to the purpose of the Swedish Experiment Station, Tamm sets up the following aims for a soil analysis:

1. Determination of the elements necessary for vegetation.

2. Determination of eventually present poisons or harmful substances for the plants.

3. Examination of chemical, physical and mineralogical processes, that take place in the ground and more or less directly are of importance to the vegetation, or otherwise are of interest.

Tamm warns against broad use of general methods. Consideration must be given to whether or not the soil in question is similar to that for which the method is discovered. Methods for agricultural soil are not good for forest soils, and soils influenced by different climates must also be analyzed in different ways. For instance, the wet soils of northern Sweden have a humid character. Extracted with HCl they give a result indicating that there is lack of easily dissolvable material, which should mean that they were poor forest soils, but this is false. The method has only told the dissolvability of the different elements in HCl and these values have no direct connection to the amount of nutrients that are available to the trees.

Tamm discusses the conditions of Swedish forest soils and because of these desirable methods. He summarizes the methods that ought to be used for Swedish forest soils as follows:

1. The complete analysis (the Bausch-analysis) including direct and indirect determinations of all the more important elements present in the soil. This method of analysis gives an expression of the total content of mineral plant nutrients and in connection with mineralogical examinations the best available expression for content in the soil of different minerals.

2. Partial analysis, the determination of the total content of one or more characteristic soil substances, as nitrogen, phosphoric acid, lime, iron, humus, limonitic iron and so on. These methods are used, when information about a certain substance is of interest.

3. Determination of reaction and degree of acidity. This examination is of importance, because there often seems to exist a relationship between the degree

of acidity in the humus and soil quality (bonität). One can also think that this degree of acidity is possible of change by human intervention.

4. Determination of the electrolytical conductivity in the soil liquid or in a water extract from the soil. When suitable methods are found, one will be able to determine the nutrients present at a given time. This is, of course, of a certain interest, even if it is the permanent fertility which is of greatest interest regarding forest soils.

5. Mineralogical analysis, in order to determine different minerals in the soil. These examinations are of value as a complement to the complete analysis, or to determine whether any of the easily decomposed lime minerals which are of benefit to the forest are present in the soil, and which can be proved only with great difficulty to be present by chemical analysis.

6. Mechanical analyses. By means of these considerable knowledge regarding structure, amount of nutrients, technical characteristics and conditions of decomposition can be gained.

Tamm recommends the following methods of analysis:

1. The Bausch-analysis is carried out as a mineral analysis. (*See* Hillebrand, W. F. The analysis of silicate and carbonate rocks. U. S. Geol. Survey Bull. 422, Washington, 1910.)

2. *Determination of lime.* ($CaCO_3$.) Vesterberg's method used. (Vesterberg, A. Über einige Analysenmethoden für Bodenuntersuchungen. Verhandl. der II intern, Agrogeol. konf., page 125-141, Stockholm, 1911.) First add very diluted HCl in vacuum and distill. Generated carbon dioxide is lead through a solution of barium hydroxide. After 12 hours, titrate with 0.1 normal HCl.

3. *Determination of phosphoric acid.* ($P_2O_5$.) By extraction with nitric acid.

4. *Determination of humus content.* A method recommended by Vesterberg (all above noted in book, page 132) and improved by the Station is used, besides the regular method of loss by heating.

5. The *total content of iron* is found out in the usual way with fluor hydrogene acid, reduced with hydric sulphide and titrated with potassium permanganate.

6. *Determination of limonites,* including some soluble iron. This method is worked out by Tamm and the principal is that ferrihydroxide $Fe(OH)_3$ easily dissolves itself in a solution of acid kaliumoxalat, generating a complex salt. $2\ Fe(OH)_3 + 6\ KHC_2O_4 = K_6\ Fe_2(C_2O_4)_6 + 6\ H_2O$.

As the acid kaliumoxalat compared to strong acids has but a very low hydrogen ion concentration, one can presume that the solution hardly attacks iron minerals. When, therefore, a soil sample is mixed with a solution of acid kaliumoxolat only limonitic iron might be dissolved.

7. *Mineralogical analysis methods.* In not too fine-grained soil, one can use separation with liquids of different specific gravity.

8. *Mechanical analysis* are carried out according to Atterbergs principles. (At-

terberg, A.: Mekauirka jord-analyser ork klauification av de svenska mineraljordslogen.) K. Lautbuuksahodemiens handl. o. tidehr., page 438-463, 1912.

TAGE BLIBERG,
*Appalachian Forest Experiment Station.*

**Bidrag Till Kannedomen om Hyggesbranningens Inverkan Pa Marken. (Contribution to the knowledge of the influence of burning on the soil of clear-cut areas.)** By O. Eneroth. *Svenska Skogsvårdsföreningens Tidskrift, III-IV, 685-758, figs. 11, tables 23, 1928.*

It is generally agreed in Sweden that burning raw humus lands is advantageous. Regarding other types, the opinions differ.

In this paper the author considers two important details, (1) changes in the soil reaction, and (2) changes in the content of active available lime.

Samples from burned and unburned areas are compared. Soil reaction was determined colorimetrically, lime by extraction with $NH_4Cl$; humus content through glowing, not greater than 550°C. To obtain an index on the physical stage of the humus, $W_H$ (after Mitscherlich) was also determined.

As practiced in Sweden burning does not reduce soil humus directly as only the slash and litter are burned.

The results indicate that pH is higher in burned areas in some cases one point or more; severely burned areas may become neutral. The changes do not show up so well in the first year as in the following years. Evidence of burning may remain for ten years. The lime shows about the same variations as the pH.

TAGE BLIBERG,
*Appalachian Forest Experiment Station.*

**Studier over Jordbundens Brintionkoncentration oz dens Betydning for vegetationen sarlig for Plankfordelningen i Naturen. (Studies on the H-ion concentration of the soil and its influence upon vegetation, with especial reference to plant distribution.)** By C. Olsen. *Meddelelser fra Carlsbergs Laboratoriet, Vol. 15, p. 1-166. 1923.*

Plants are known to differ in their preference or tolerance for an acid, and a neutral or a basic soil reaction. Previous investigations have also shown that nitrification in the soil is influenced by the soil reaction, and this fact is particularly significant in the distribution of plants dependent upon an abundance of available nitrates. The object of the present paper is to show further that soil reaction has a direct influence upon vegetation and that it is an important factor in plant distribution. The present study is both ecological and biological in character.

Present investigations include meadows, forests and cultivated soils from 187 localities. Vegetation is described by means of Raunkiers formation-statistical method. From each area a

composite soil sample was taken from a mixture of two or three separate samplings. Both electrometric and colorimetric methods were employed for the determination of pH.

To study a single vegetation factor it is desirable to select areas where all other factors are uniform except the one in question. In these studies uniform light conditions were most difficult to obtain. Even when areas of uniform light conditions were found, there was no positive evidence that the vegetation present was an expression of the same light conditions as occurred at the time of observation.

All data were statistically compiled. Localities are separated in classes with different pH from 3.5-7.9. The classes were arbitrarily divided into a range of 0.5 pH. The frequency of different species is computed for the different classes in Table 1.

In addition to Table 1, curves are presented that show graphically the relative abundance of a species in each pH range. It is aso shown that both the number of species as well as actual total number of plants is largest in neutral to slightly alkaline soil pH 7.0 to 7.4, and that both decrease as the reaction becomes more acid.

As different plants occur only within certain pH limits the vegetation may be used as an indicator of soil reaction. However, one cannot expect great accuracy by this method alone because a single species may be insufficient basis for determination, and because indicator plant species may not be sufficiently numerous.

Olsen has also studied nitrification in the soil. He finds that the nitrification was active in all but sour podsol-formations (pH 3.5-3.9). In this case quantities of ammonia are produced. It was found that in general the greatest amounts of ammonia were generated in the sourest soils and the least in the alkaline soils, where the nitrification is taking place more completely. When "podsol" soils are excluded, there could not be shown any relation between composition of vegetation and nitrogen cycle and neither between the H-ion concentration and the course of the nitrogen cycle. The nitrification could be as high in soils with pH of 4.0 as in neutral or basic ones.

In a beech stand without forest ground cover the pH was 3.7-3.8; no nitrification was present but there occurred a fair amount of ammonia generation. Sour soil and too little light probably accounted for the absence of herbaceous vegetation.

TABLE 1

| Species | pH 3.5—3.9 | 4.0—4.4 | 4.5—4.9 | 5.0—5.4 |
|---|---|---|---|---|
| Vaccinium | 100 | — | — | — |
| Deschampsia | 76 | 86 | — | — |
| Carex | 18 | 14 | — | — |
| Anemone | 10 | 61 | 88 | 76 |
| Oxalis | 20 | 62 | 74 | 78 |

The individual numbers in this table indicate the number of times a species was present in the plots examined; expressed in percent of the total number of plots.

### ALTERATION IN THE H-ION CONCENTRATION, WHEN THE STAND IS CLEAR-CUT

To study this question a suitable area was selected and conditions studied before and after cutting.

In the dense uncut spruce-stands pH was very sour (3.4-3.6); nitrification was absent but ammonia was present. After cutting, *Senecio* sps. came in during the first summer. The pH changed from 3.5 to 5.0, making nitrification possible. Both nitrification and ammonia production occurred, the former being double the latter. The author does not attempt to account for the better humus decomposition but considers light to be the probable factor. Three to four years after the clearing, *Chamaenerion* and *Rubus* were dominating plants. At this time the H-ion concentration increased and the nitrification decreased; *Deschampsia* was entering the areas. After four to five years the H-ion concentration was the same as it was in the spruce stand, and the nitrification had ceased.

The author found a very similar course of soil changes under clear-cut beech forests.

### CULTURE EXPERIMENTS

Based on the findings from the above experiments Olsen proceeded with culture experiments in which the pH was controlled between pH 2.0-7.5. *Deschampsia* and *Senecio* were used as acid soil plants and *Tussilago* as a representative of plants favoring more alkaline soil. It was found that the plants were able to alter the pH in the rotation, but as pH was carefully controlled the plants were considered to be grown at the original pH of the solution. After two months the plants were weighed and the maximum plant weight for each species used as a basis for comparison.

*Deschampsia* and *Senecio* were found to have their maximum over a pH 4.0. *Tussilago* pH 6.0-7.0. It was found that in these studies even plants showing preference for an acid soil in nature were able to grow at pH of 7.0. Olsen believes that around the plant roots, the culture solution is more acid than in the soil extracts.

These results indicate that the H-ion concentration exerts a direct influence on the plants.

Some indirect influences of H-ion concentration on plant growth and distribution were also studied, as for example, soil reaction as influencing nitrogen circulation. In order to find out the demand for nitrogen compounds of different plant species, plants were grown in sand cultures with varying sources of nitrogen. *Deschampsia* preferred $NH_4Cl$ and $NH_4NO_3$ and turned yellow-green in $NaNo_3$. *Tussilago* and *Mercurialis* did not grow in $NH_4Cl$. They were much better in $NH_4NO_3$, but died suddenly after a time. In $NaNO_3$ these two species grow well. These observations seem to show that while *Deschampsia* prefers $NH_4$ salts it is able to live with $NaNO_3$ as a nitrogen source. The other plants studied were not able to use $NH_4$ salts. The pH which at the start of the growing period was 6.0, changed to a lower value with the $NH_4$ salts but became higher in the $NaNO_3$ culture. This is accounted for by the withdrawal of certain ions. The experi-

ment was repeated except that the pH was kept constant. The plants grew equally well whether the nitrogen source was $NaNO_3$ or $NH_4Cl$. Still further experiments substantiated these results. Olsen concludes that different types of N circulation in the soil has little influence upon the distribution of plants.

The American theory, that aluminum-ions in sour soils are injurious to plants preferring more neutral soil but not to plants preferring acid soil was investigated. Olsen was able to substantiate this theory for only the plants favored by alkaline soil.

TAGE BLIBERG,
*Appalachian Forest Experiment Station.*

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**Forskellige vegetationstypers forskellige indflydelse paa jordbundens surhedsgrad. (Influence of different vegetation types on soil acidity.)** By C. Raunkier. *Det. kgl. daurhe Videnshábernes Selstrab. Biologishe Meddelsher, Vol. III, 10, p. 74, 1923.*

Raunkier reviews Carsben Olsen's paper: "Studies in the hydrogen-ion concentration in the soil and its significance to the vegetation, with especial regard to the distribution of plants in the nature." Olsen's work establishes the fact that the H-ion concentration of the soil is of importance in understanding the distribution of different plants in nature. It is also important to learn whether plants influence the H-ion concentration of the soil or not, and if such is the case, the extent of this influence. If it can be demonstrated that a species, a formation, or a formation type influences the pH of the soil in a certain direction, then it must follow that a certain formation or a formation type in the long run alters the original condition and may perhaps cause its own destruction by altering conditions to favor another plant formation. The author proceeds to study these problems.

For determining H-ion concentration the colorimetrical method was used.

Because apparently similar plots may give considerable variation in pH values, the author has examined five samples. The author does not recommend mixing these samples but prefers to examine each sample separately. This variation is of significnace for a real understanding of the nature of a plot.

Data on variation of pH at different soil depths were obtained. In a seventy-five year old spruce stand the soil was less sour with greater soil depth. The difference, however, was small and much smaller than the largest difference between separate samples at the same plot. On an unforested area the conditions were reversed.

These observations are explained as follows: On vegetated areas—a spruce stand, for instance—the vegetation makes the soil sourer, and in comparatively young stands will become less sour with increasing depth because the deeper layers have been less influenced than have the upper. On the other hand, after cutting followed by cultivation the pH will increase more rapidly in the upper layers.

The forest area studied is located not far from Copenhagen (Dyrehaven).

Because of the abundance of grazing animals, the forest is not able to reproduce itself. In open grassy areas plantations had been made inside fences affording stands of different ages, together with herbaceous vegetation, on similar soil conditions. The areas of herbaceous vegetation, now chiefly grass areas, but once old forest, offered an opportunity to study the development from grass areas to forests.

The results of the investigation are given using the author's classification.

A. Grass areas—spruce forests:

In six localities the degree of acidity is determined, partly in old grass areas and partly in adjacent planted spruce stands.

Data show that the average pH for the grass areas is 6.05 and for the spruce stands 4.03, a difference of 2.02 pH units, and also that in general the difference between grass areas and forests increases with increasing age of the tree stands. The conclusion is that the spruce stand has made the soil sourer in the six localities by at least 2.0 pH.

B. Grass areas—beech forests.

From the tables it can be seen that in all examined localities the beech stand shows a soil more acid that in corresponding grass area, but the difference is far smaller than in the case of spruce stands, namely 0.8 pH units. The actual averages are pH 6.06 for grass area and pH 5.26 for the beech stand.

C. Grass areas—oak forests.

As the three oak stands studied differ as to light, wind conditions and soil vegetation, they have been considered separately.

In the first case it is apparent that the soil from the oak stand was considerably more sour than from the grass area, namely, about one pH unit (varying from 0.64-1.36) and it is also comparatively sourer than that of the beech stands. (The average pH for the grass area is 5.91 and for oak stand 4.87.)

In twenty to thirty-year-old oak plantations, with some beech, the pH average was 4.26, and for the oak stand 6.09. The oak forest is 1.8 pH units sourer than in grass area which approximates conditions for the beech forest. In this example, however, the conditions in the oak stand were rather similar to those of a beech stand.

The third instance was a sixty-five-year old open oak stand having a forest floor of herbs. Here the average for the grass area was 6.05 pH and for the oak stand 5.66.

In a comparison with other types the open oak forest had the least influence in changing the soil of the original grass area. For an average of six tests the difference between grass area and forest area is but 0.39 pH units.

In three comparisons spruce gave an average pH 4.01, beech pH 5.11. In the average for six other localities pH for beech was 5.29 and for oak 5.97 pH.

After having shown, that forests make the original grass areas more acid,—in different degrees according to the species, the author has inquired if this process is reversed when the forest is removed and the soil again becomes covered of grasses.

Samples from three localities in the experimental forests, which was cut seven years earlier, gave as a result, that

the acidity was lessened by an average of 1.17 pH units by transition from spruce to grass. Five other samples, partly from the same area, gave an average of 0.88 rise in pH.

Similar results were found in natural grass covered openings in the old beech forest in Dyrehaven.

The conclusion from the above studies is that forests tend to increase the soil acidity.

The author is of the opinion that it may be assumed that the ability of forest types studied to increase the soil acidity is in the order of spruce forest, beech forest, oak forest. But, when one observes that the degree of acidity is proportionate to the ability of the tree species in question to shade the ground, it may be that the acidity does not depend upon the direct effect of the species as much as of the different conditions, which different species bring forth. The author considers shade which in dense spruce and beech forests prevents the herbaceous forest floor vegetation from becoming established. Hence, the evaporation is greater in the upper soil layer which becomes dried out by the wind, sweeping over the soil unprotected by ground cover. This drying of the soil offers poor conditions for the microflora and consequently, retards biological processes in the soil.

By means of an atmometer, the author observed the evaporation conditions in different localities. These observations showed very significant influence of forest cover in reducing evaporation from the soil surface.

The author concludes his discussion by stating that if a low H-ion concentration is the desired condition to be developed, then it would be considered advantageous that the stand becomes so light that the forest floor can be developed as a dense cover.

However, there are other important factors than the acidity. The components of the floor in a very light stand consume the nutritive substances in the soil among other things. These plants take large quantities of water from the upper layers, which in such a way deprives the trees. Therefore, it is probable that the best type for the Danish climate is a stand which is so light, or perhaps so shaded, that a flora, consisting of a store of more or less broad leafed plants, which not entirely excludes the light from the ground but at the same time offer wind protection so that the upper layer will not become dry but be kept favorable for biological activity and root nutrition.

Translation of Danish review.

TAGE BLIBERG,
*Appalachian Forest Experiment Station.*

**Undersogelser over jordbundens reaktion og nitrifikationsevne i typiske danske bogeskove. (Investigations of reaction and nitrification in typical Danish beech forests.)** By Tr. Weis. *Meddelelser fra Dansk skovforenings godslingrförröz, Vol. 4, p. 81-232, 37 figs. and plates, 25 tables, 1924. (Translation of a review in Norwegian.)*

This work, which is a part of the forest soil fertilization experiments carried

out by a Danish forestry association, considers chiefly the conditions governing the formation of the forest soil type called "mor" in stands with beech and other broadleaf trees. It is known that in the development of this soil type, worms and other animal life disappear and their beneficial effect in altering the soil layers is lost. Where such a "mor" generation has taken place it is very hard to get natural reproduction of beech. Seeding or planting is not always successful without preceding it by cultivation or lime fertilization of the soil. It also happens that one does not get reproduction where the soil is a typical "mull" (brown soil type). Also, there are areas of good beech stands, where the soil is sour and apparently lacks lime.

This investigation considers 780 soil samples from twelve different districts, comprising 551 hectares. Determinations are made of moisture, content of nitrate, nitrification ability, and soil reaction. The latter was qualitatively determined by means of litmus and with so-called Comber-test (alcoholic solution of rhodankalium). Quantitatively, pH was determined colorimetrically and when possible, it was controlled by electrometrical determination.

The principal results may be summarized as follows:

1. The top layer of the soil, down to a depth of about 10 cm. has almost always been acid, in some instances very acid.

2. The highest degree of acidity is not found in the soil of the poorest forests, but in some of the very best with an average from 4.0 to 4.6, while the medium productive forests and the remainder of the best forests have shown an average acidity of about pH 5.00-5.70.

3. Samples from lower layers in the ground generally have been less acid than samples from upper layers in the same plot, and they often have shown a neutral or slightly basic reaction, where the upper layers have been quite acid.

4. In the plots with poor beech forests nitrification does not take place. This process has been common in all the other forest types even in plots with relatively high acidity.

5. In samples from deeper layers, as a rule, nitric acid is absent or present in rather small amounts. This can originate from upper layers, since evidently there is no nitrification taking place in the lower layers.

Since there exists no relationship between soil acidity and the thrift of the stand, one can think that this is dependent on other factors, on the nitrification ability, on content of suitable electrolytes, on the ability of nitrogen containing humus compounds to generate ammonium, and the ease with which the vegetable humus decomposes.

The author inquires also into the lime requirement in soils, where the beech thrives well, reproduces itself and where in spite of acidity active nitrification is taking place.

It is evident that many "mor" soils show a decided need for lime and when lime is supplied and the soil cultivated, they support a thrifty stand of beech. It is also certain that if the soil in the very best beech stand should be used for farming, it has to be supplied with

a great quantity of lime in order to make it yield satisfactory crops. By the natural elutriation processes in connection with nitrification and carbon dioxide generation in the soil, there will be a disturbance of the balance in the upper soil layers in so far as the bases are removed faster and acid reaction will result. As Ramann and Fenk have shown, the presence of carbonic calcium will have a slight influence on the supply of other important plant nutrient substances as potassium, magnesium and phosphoric acid. By supplying lime at the right time one may counteract the depletion of the soil and prevent a "mor" development which is so harmful to the beech, or even change the incipient "mor" to a "mull" when the deterioration has not proceeded too far.

It is pointed out that lime may be required on soils in which it is abundant in the subsoil, as the upper layers may be quite acid even if the lime rock lies comparatively close to the surface.

Where the beech is dying out, the author believes that the soil is so altered that lime is of no use in restoring the stands. The soil exhibits "beech weariness" which cannot be helped by supplying lime or cultivation. It is of more advantage to use a rotation and adopt other species.

The author recommends avoiding pure beech stands by favoring other tree species that permit more light to enter the stand.

There is no doubt that the beech as well as the spruce is a pronounced shade tree, which reacts unfavorably on the soil when grown in pure stands. Introducing only a few "light trees" such as oak, ash, larch, or pine, which tend to prevent a typical "mor" development will encourage conditions for a thrifty ground vegetation of different herbs. This will tend to favor biological activity that has been reduced in the dense beech stands, and to hasten litter decomposition, nitrification and nutrient exchange in the soil.

TAGE BLIBERG,
*Appalachian Forest Experiment Station.*

# BRIEFER ARTICLES AND NOTES

## Problems of the West Coast Lumber Industry Discussed by Greeley

In an address before the Western Division of the Chamber of Commerce of the United States in Portland, Oregon on December 9, Colonel William B. Greeley, Secretary-Manager of the West Coast Lumbermen's Association, gave the business men there assembled a clear picture of the problems confronting the lumber industry of the West Coast. What he said of the industry in his region applies in large part to the industry as a whole the country over.

Reviewing first the acquirement of virgin timber in western Oregon and Washington by private owners, Col. Greeley showed how the expected returns from such ownership on account of an expected increase in value due to a decrease of timber supply, failed to materialize. He drew attention to the profound changes in the habit of using wood and the entrance of competitive materials, forcing lumber to meet sharp competition where it once sold itself. Continuing, he said, "And so the new lumber industry of the West began to find itself between an upper millstone of raw material which it had taken upon its shoulders and a nether millstone of markets which were diminishing and more difficult to hold," and proceeded to show how the industry seeks to meet its problems; thus "As it seeks to meet these problems, a progressive change is taking place in the industry itself. It is emerging from the old order in which its main reliance was upon the ownership of a natural resource. It is entering a new order whose keynote is industrial efficiency." Improved manufacturing, improved utilization, modern merchandising and general industrial efficiency based upon intelligent research are the hope of the industry. "It is important to emphasize these facts at the outset. It would be futile for the lumber industry to invite public discussion of certain of its major problems, and particularly to suggest further public coöperation in their solution, without clearly recognizing the necessity for many internal betterments which the industry alone can accomplish." Thus the industry, through one of its most respected spokesmen, boldly faces the necessity of internal changes before it can seek and expect public sympathy and aid.

One of the most important problems of the industry is an adjustment between production and consumption. In the Douglas fir region there are at present 695 living saw mills having a capacity of 15 billion board feet or 25 per cent more than the industry has sold in its best year. The West Coast lumbermen have already taken courageous action to correct this fundamentally dangerous situation. They have reduced produc-

tion from 75 per cent of their manufacturing capacity in 1928, a good year, to 54 per cent in 1930. The current business depression has reduced orders to 55 per cent of manufacturing capacity, forced a decline of 30 per cent in the average price of lumber sold as compared to 1929, and caused the shut-down of 291 mills and the unemployment of from 40,000 to 50,000 men. "The West Coast Lumbermen's Association has valiantly attacked this giant with the weapons of fact, education, and persuasion. We have persistently put before the manufacturers the current facts as to production, orders, stocks, and market trends. We have unremittingly urged moderate production programs to keep the situation in balance from month to month. We have preached the economic gospel of manufacturing what can be sold at a fair price rather than running full time and then selling what has been manufactured at any price. We have had a fair measure of success. But the problem is too deep-seated to yield to educational methods alone. A more definite and business-like basis for a continuing, orderly control of production by concerted action throughout the industry must be found."

Overproduction is the industry's chronic ailment. The burden of carrying a long-time supply of timber has created a tremendous financial pressure for liquidation. This burden is a basic weakness and has made lumbering simply a liquidating industry.

Colonel Greeley sees no solution but by much consolidation, and he makes a strong plea for self government by the industry requiring a liberalization in anti-trust laws. "At the present time, the right of the law-abiding manufacturer to coöperate with his neighbors in maintaining a sound relationship between supply and demand is practically limited to gathering and disseminating statistics. Beyond that point he enters a twilight land of legality at the risk of frustration of his plans and criminal prosecution for himself." . . . . "There should be no question of changing the basic competitive principle upon which the anti-trust laws were built. But there is a serious question, in my mind, if the public interest does not require putting a curb on the destructive forms of competition, especially where the waste of natural resources or stable employment of labor under desirable conditions are involved. And let the curb be applied by the industry itself, through the right of agreement among its members under reasonable and proper safeguards.

"In other words, is it not time to substitute for the sweeping condemnation of any and all restraints upon competition as contrary to public interest, which is now written into the anti-trust laws, a more discriminating determination of the kinds of concerted action within an industry which actually promote public interest and national welfare?

"It should not be difficult to express this principle in law. It would require giving some competent and disinterested umpire authority to determine what forms of industrial coöperation are, or are not, in the interest of the public, considering all phases of public interest or welfare that may be involved. Coöperative efforts to restrain destructive competition and utilize our natural resources sanely, or to promote stable and satisfactory conditions of employ-

ment, for example, should be sanctioned if actually found, upon disinterested examination, to be in the interest of the public".

Colonel Greeley's own plan is one of self-government under a public umpire. Both the initiation and execution of any programs adopted would rest with the industry, and it would be permitted to determine what coöperative action within its ranks is necessary and practicable to keep production in balance with demand, prevent avoidable waste, and stabilize employment. If the plan is in the public interest and is approved by the umpire, the industry would have the authority to put it into effect through its own organization and internal agreements. (One naturally asks, hopes really, that the new National Timber Conservation Board will lay the foundation for such authority and possibly become a continuing public agency to serve in the capacity of Col. Greeley's umpire.)

Col. Greeley closed his address with the following: "The lumbermen of the Northwest have been trained in a school of intense individualism. It is a natural result of the pioneer conditions under which their industry has developed. But they are rapidly learning the necessity of coöperation. They are realizing that many of the complex problems which surround their industry today can be dealt with far more effectively by united action. They are more and more prepared, with the aid of coöperative action, to work out the problems of utilizing the vast forests of the West with the efficiency in manufacture and merchandising demanded of them by modern conditions.

"Their industry is not a decadent one. It will go right on fabricating the innumerable things required by civilization out of the timber resources of this region. It will perpetuate those resources through reforestation. It will remain a great employer of labor. It will shoulder the responsibilities of conserving its raw material and making it of the maximum benefit to the people and commerce of the United States. But to do these things effectively, and particularly to restrain the destructive competition which benefits no one, they need greater freedom of self-government".

E. F.

### Original Forests of Cape Cod

Cape Cod and the adjacent region of Massachusetts was settled nearly 300 years ago and rapidly cleared of its timber by the early settlers. Because of the level topography, the sandy nature of the soil and the constant winds and repeated fires, any attempt by nature to reclothe this land with the original type of forest might well have been frustrated, so that gradually the original climax type was wiped out and succeeded by a fire-resistant type which bears no resemblance to the original forest. The key trees of this fire-resistant forest are pitch pine, (*P. rigida*) bear oak (*Q. ilicifolia*) and scrubby forms of white oak (*Q. alba*), scarlet oak (*Q. coccince*) and black oak (*Q. velutina*). In a few isolated spots where fires have not been quite so prevalent a few white pines survive and in the swamps will be found red maple (*Acer rubrum*) and white cedar (*Thuya occidentalis*).

People have realized, of course, that the present type of forest is the result of long human occupancy of the land. We have frequently been asked what was the character of the original forest and could give no satisfactory answer. A search of old records gave but little help. The original settlers were not botanists and their descriptions of the forests are so general in character as to give but little clue to the precise species of trees that they found there. That white pine, now rare, was formerly abundant is indicated by its use in the old houses and by the term "mast road" given to some old forest road, indicating that white pine masts for ships were once hauled out on that old highway. That hemlock, known to the early settlers as "spruce" but now practically unknown on Cape Cod, once grew there is indicated by the terms "Spruce Pond" and "Spruce Swamp" given to certain localities.

I recently had an opportunity to visit two islands, one in Halfway Pond in Plymouth and the other in Wakeby Lake in Mashpee, on which there is growing a type of forest entirely different from that of the nearby mainland, due as I believe, to the fact that they have been protected from fire by the surrounding water. I would not claim that in either case these islands have the original primeval forest in the sense that they have never been cut over, but that when cut off they were not burned and reproduced a type not greatly different from the original stand. The island in Halfway Pond is covered with hemlock, white pine, beech, soft maple and black and yellow birch. The pitch pine and oaks so common on the nearby mainland are missing. The island in Wakeby Lake has beech, soft maple, black birch, tupelo, hornbeam, a few white pines and red oak, the latter a rare tree in the present Cap Cod forests. There are no hemlocks. In neither case is the soil on these islands any better than that of the average Cape Cod woodland, although the proximity to water produces a somewhat better site condition than that of the gravel ridges of much of the mainland.

Therefore I would state it as my belief, based on the conditions found on these two islands, that the original forests on the Cape or at least on the western or mainland end of the Cape, contained a much larger variety of trees than are represented today, that the present prevailing pitch pine-oak type of forest was confined to the poorest sites, that the type of growth on the Cape forests did not vary materially from that of the primeval forest generally present over southern New England, and that the idea quite prevalent, even among the residents of Cape Cod, that because of soil and climatic conditions, and though protected from fire, their forest lands are not capable of producing a stand much better than the present scrub growth is not founded on sound facts.

H. O. Cook,
*Chief Forester, Massachusetts Department of Conservation.*

### The Mesquite Circles the Globe

Seeds of the algaroba or mesquite (*Prosopis juliflora*) which were sent

about a year ago by the writer, at the instance of Rev. A. S. Baker, from Honolulu to Bahrein, have not only germinated but the young trees resulting from the importation have survived the long, hot summer of 1930, and in a little less than a year after planting are six feet high.

Bahrein is an interesting but barren island, about 26 by 8.5 miles in size, off the east coast of Arabia and is the center of the Persian Gulf pearl fishing industry, which supplies some three-fourths of the world's real pearls. The island is very picturesque with its prehistoric burial mounds, minarets, flat-roofed towns, and much sun-baked and weird desert with camels here and there. With the exception of date palms, the barren island is practically devoid of tree growth and was sadly in need of a tree that would supply shade against the scorching sun, feed for animals, and firewood. The island has to import great quantities of firewood from Persia.

The mesquite seemed to be just the tree to fill the bill and has already begun to produce the hope-for results. It is not only now growing on Bahrein but a part of the seed from Honolulu was taken by a member of the American Dutch Reform Mission to an oasis in the interior of Arabia where still greater hopes are felt for its successful growth.

The mesquite, or algaroba as it is called in Hawaii, has been a God-send to this group of Pacific Islands because since its introduction by Father Bachelot in 1828, it has been spread, by the seed germinating from the manure of cattle and horses, over 100,000 acres of what were formerly dry and barren lands on the lee side of the islands. This is now the commonest and most valuable of introduced trees in Hawaii for its wood makes a valuable fuel and durable posts, its flowers bear a delicious, pure, white honey which is harvested and exported by the ton, and best of all its slim, golden, sweetish pods supply a fattening fodder for stock at the dry season when the native grasses are parched.

Although a native of tropical America, the algaroba was first introduced to Hawaii in the form of a seed which came from the Royal Gardens in Paris. Quantities of mesquite seed have been sent from Hawaii to Australia, the Fiji Islands, and to South Africa. Now that it has been sent with Hawaii's greetings to a parched and barren island in the Persian Gulf, it has practically completed its romantic circuit of the globe, distributing its blessings wherever it has taken root.

C. S. Judd,
*Territorial Forester, Hawaii.*

## Successful Storage of Longleaf Pine Seed

Tests recently completed by the Southern Forest Experiment Station show that successful storage of longleaf pine seed is not impossible or even difficult. Seed stored at low temperatures in tight containers germinated well a year or even

TABLE 1

GERMINATION OF LONGLEAF PINE SEED

| Crop | Method of storage | Germination per cent | | |
|---|---|---|---|---|
| | | Fresh | After 1 year | After 2 years |
| 1927 | Sealed glass jars at 25°-30° F. | 85 | 81 | 82 |
| 1928 | Friction-top can in ice box, 60°-70° F. | 89 | 75 | — |
| 1929 | | 49.2 | 28.4 | — |
| 1929 | Loose-covered cans in fish house, 20°-60° F. | 46.8 | 26.4 | — |

two years after collection. Records of the tests are given in Table 1.

In a commercial nursery test reported to the Station, longleaf pine seed of the 1927 crop that showed a germination percentage of approximately 80 when fresh showed one of approximately 50 after being stored in loose-covered cans at air temperature from November to May and at temperatures near freezing from May to February.

The figures give some indication that the more tightly covered the containers, the better the result.

In general the germination of cold-storage longleaf pine seed has been as prompt as that of fresh seed, if not more prompt.

No other method of storage that has come to the attention of the Southern Station has so consistently preserved the vitality of longleaf seed. The Station recommends that state forestry departments and lumber companies having surplus longleaf pine seed of the current crop put the seed, thoroughly dry, in tightly covered cans and keep it at 32°-35° F. until it is needed for use a year hence. It is expected that the method will work equally well with seed of slash, loblolly and shortleaf pines.

PHILIP C. WAKELEY,

*Southern Forest Experiment Station.*

## NOTES ON GROWTH OF SLASH PINE IN TEXAS

The first known planting of slash pine in Texas was made in March 1926 by the Texas Forest Service. At this time a total of 3 acres was planted, on the State Forest in Newton County, with stock secured from the nursery of the Louisiana Forestry Department. The first area planted at this time included 1.3 acres and thrived from the beginning. The remaining area, 1.7 acres, was planted later in the month with stock that was delayed about two weeks in reaching the planting site. The roots had dried out and a low survival resulted. All of this stock at time of planting was approximately one year old.

Beginning in the spring of 1929 slash pine has been planted each year in various parts of the Texas "piney woods" region. To date the species has shown most promise on longleaf sites, except in Nacogdoches County, where trees planted in December 1929, on red clay in the loblolly-shortleaf type, are showing excellent survival and extremely rapid growth.

Records kept on the 1.3 acre plantation at the Newton County State Forest (now designated Plantation 26C) indicate what may be expected of slash pine in Texas on average sites:

1,180 trees were planted

572 tagged trees survived in January 1931.

In the winter of 1926-27 rats and rabbits did so much damage to the plantation that early in the following spring every tree was reported dead or dying. Recovery from this damage has been remarkable. Each year up to 1930 several trees lost their leaders because of a borer (as yet not identified) that worked from the terminal bud down through the pith; yet these injured trees in almost every case formed a new leader and as a rule kept up with the average height growth of the plantation.

The trees were eight to ten inches tall when planted. When measured (100 per cent of total trees) in January 1931 the average tree was 8.92 feet high; the average diameter, breast high, of all trees over 5 feet tall (504 trees) was 1.66 inches and the basal area for the plantation was 8.46 square feet. The smallest tree measured was 1.5 feet tall; the largest measured was 14.83 feet tall and 2.6 inches, d. b. h. The largest diameter found was 3.0 inches on a tree 14.58 feet tall.

The average tree shows a consistent increase of 1.87 feet in height for each half inch of diameter growth. Most of this growth occurs between January and July, although practically every tree measured showed an appreciable growth in height or diameter or both, during the last half of the year, (between July and January).

Temperatures to 5° F., (the lowest yet recorded) do not injure slash pine over a year old. Newly planted year-old seedlings are not seriously affected, but there was more loss to seedlings grown in our Montgomery County nursery (in the loblolly-shortleaf country) than to those grown in the Newton County nursery, although the seed used at both nurseries was purchased from the same source and not separated in shipping, and the trees observed were all planted at the same time, an about the same soil and in adjoining plantations. Practically all slash pine seedlings grown in the Newton County nursery take on a purple tinge when cold weather strikes them. The Montgomery County seedlings, on the other hand rarely take on the purple tinge, but usually remain the natural green or else turn brown and dry. Since the seed is from the same source and same sack, this difference in behavior seemingly is due to different nursery soils. Or what?

Foresters familiar with slash pine in its native home, who have observed the Kirbyville trees, almost invariably comment on the difference in the general shape and appearance of the Texas grown trees.

Because of its rapid growth and because of the recent publicity given slash pine as a new source of pulp for newsprint, the demand for slash pine planting stock is growing in Texas. We cannot yet say that it will ever make sawtimber here, but the indications are good that it will produce an abundance of pulp wood in ten years or less from the seed.

C. B. Webster,
*Texas Forest Service.*

## Timber Type Mapping from the Air

The mapping of timber types has

been accomplished mainly by timber cruises. As an adjunct to this method more extensive means have also been employed. The latter has usually meant getting on the highest point possible within the area to be typed and sketching in the types on a topographic plat. The intensive timber cruises give an accurate presentation of the situation whereas the extensive method is subject to considerable error, especially when the balance between one species as against another will determine the type. But the latter method is considerably cheaper than the first and because of this fact has been used to a great extent.

Mapping directly from the air comes under the extensive class. Its use has been limited, in fact, very little attention has been paid to its possibilities. This summer, however, the El Dorado National Forest tried out timber type mapping from an aeroplane with success.

The Long Canyon Division of the Auburn Working Circle, on the El Dorado National Forest in California, has never been cruised. It comprises an area of approximately 67,000 acres. The south boundary of the division is the precipitous canyon of the Rubicon River and the north barrier is the steep gorge of the Middle Fork of the American River. The western boundary is formed by the convergence of these two streams and to the east the boundary is the crest of the Sierra Nevada Range. Through the approximate center of this area flows the stream from which the Division derives its name, Long Canyon. Thus there are two prominent ridges that serve as excellent guides for the air pilot. There are no high points from which one can see over the entire area. The inaccessibility of the region, the lack of auto roads and prominent peaks made the type mapping of this area a problem. As a consequence the aeroplane was resorted to.

Before taking to the air the mapper took a five-day trip through the area locating points for reference. A topographic map, subdivided into sections, was used as the base map. This preliminary ground trip was followed by taking to the air, flying at an elevation of 1,000 feet above the ground, and sketching in the types on the base map guided by the topography. The types were determined by visual observation while flying at this altitude. Colored crayons were used to designate the various types and were sketched in as the plane flew over the area. It took only twenty-five minutes to map the Long Canyon Division.

Then followed a trip, on horseback, over the area actually checking conditions on the ground against the map. The results were most satisfactory and exceeded even the best expectations. It must be understood, however, that finite gradations, such as 15 per cent of the type being Sugar Pine, were impossible of determination. However, the Blister Rust Control survey parties have covered practically all of the Sugar Pine areas within the National Forests. By reference to the maps made by this agency the Sugar Pine types can be determined.

The tree species can be determined from the air. At first, there is some difficulty but after a few trips the mapper can identify a western yellow pine, an incense cedar, sugar pine or white fir very easily.

What had been a problem became a job completed. To cruise this area would require a timber survey party a good portion of a field season and to obtain the type map by extensive trips through the area would have required a month's time with unsatisfactory results. The aeroplane method accomplished the task in a satisfactory manner and with the greatest speed and lowest cost conceivable.

ARNOLD N. WEBER,
*El Dorado National Forest.*

*Ed. Note.*—This article is of special interest because the sketching was done directly from the aeroplane and without the use of the camera.

## SPAULDING ADDRESSES NORTHERN ROCKY MOUNTAIN SECTION ON PRIVATE FORESTRY

At its meeting on December 15, the Northern Rocky Mountain Section was addressed by Dean T. C. Spaulding of the Forestry School, University of Montana, who gave an interesting paper on the "Objectives of Private Forestry in the Idaho-Montana Region." He prefaced his views by saying that they were his own personal ideas and impressions of the situation as gathered from timberland owners over the United States at large.

Dean Spaulding felt that in general our progress as professional foresters in selling forestry to timberland owners has met with rather indifferent success in spite of 50 years of propaganda toward that end. He feels that we have made good progress in getting public legislation and in interesting the general public who are not financially involved. However, this program has left the small owner indifferent and the large owner with a variety of attitudes ranging from outspoken antagonism to a lively interest with little attempt to apply forestry in the woods. He believes that this is because forestry propaganda has been directed to the public at large and not to the private owner.

Professor Spaulding's impressions of the present situation are as follows: 1. Antagonism has been created by charging the operator with "timber mining," *i. e.*, devastation where as close utilization was practiced as economic conditions permitted. 2. The movement to put submarginal farm lands in forest is discouraging to timberland owners who fear future overproduction. By European standards our forest land (450 to 500 million acres) will supply 600 million people. 3. The private owner feels that professional foresters are theorists, and is afraid to trust their views. He feels that foresters have damned the lumberman for slackness when they might better have offered constructive criticism. 4. Private owners are despondent and disinterested because of the unprofitable condition of the lumber industry. 5. Private owners fear legislation forced upon them by the public against their will. 6. Above all, they are not convinced that forestry will pay.

As to the future, Dean Spaulding made a number of interesting predictions: 1. The fire protective association as we know it today will pass out of the

picture and protection will be handled by federal and state agencies, but mostly locally as the problem is handled today within corporate limits. Probably the state forester will be given charge of these activities. 2. The lumber industry is in the midst of a revolution in production. Fabricated woods will come into their own and the objective of forestry will be to raise cellulose instead of sawlogs. 3. Proper taxation will come whenever the private owners do get interested in raising timber. 4. The future will see much closer coöperation between federal, state and private agencies.

A long and lively discussion followed this address.

Koch thought with Spaulding that timberland owners are not yet convinced that forestry would pay. He felt that Spaulding was somewhat pessimistic about the dangers of overproduction due to our immense timberlands and that the European standards of consumption set up by Spaulding as a measure of future needs per capita were too low for American conditions. Hornby also felt that we would not come down to European standards. He also called attention to the fact that one large western Montana company had within the last five years purchased a 30-year supply of stumpage. Parker called attention to the fact that we have made progress in fire protection. Williams said that in the East many private owners are interested; but that the states are particularly so. New York State, for example, is planting large acreages and taking other large-scale measures to hold the pulp industry within her boundaries.

I. T. Haig,
*Reporter.*

## What the Private Timberland Owners Are Doing and Have Done in Forestry in the Adirondacks[1]

The Adirondack mountain region of New York contains 4,600,000 acres of forest. Of this 1,982,925 acres are in the Forest Preserve, the balance or 2,617,075 acres is in private ownership. Of this ownership a million and a half acres are represented in the Empire State Forest Products Association, mostly in individual holdings of one thousand or more acres.

What have these private owners done; what are they doing in forestry? The question is not easily answered. In the fundamentals of protection of forests from fire, insects and disease, they have coöperated with the State and with other agencies in bringing about a marked improvement in losses due to these causes.

In improved utilization the operating owners have likewise made great progress. But it is in timber growing—in making their holdings continuously productive—that the test of forestry practice by private owners lies. What have they to show in this respect?

The answer here is as variable as the ownership involved. Some owners, it is admitted, have followed a "cut out and

[1]Presented by the author as secretary of the Empire State Forest Products Association before the N. Y. State Economic Council at Utica, N. Y., November 18, 1930.

get out" policy. But by far the majority of the owners, feeling that they are going to hold their land indefinitely, have regulated the cutting so as to take only the mature, ripe timber and to leave the smaller trees and young growth to restock the forest. This method of cutting generally involved cutting to a diameter limit and was usually confined to the softwoods, as the hardwoods had but little immediate market. Furthermore, with the practical suppression of forest fires, the natural recuperative power of the region came into full play and it is no exaggeration to say that the areas cut-over for softwoods to a diameter limit within the past decade, show a surprising volume of growing timber, mostly, of course, of the younger age classes.

Economic changes have contributed to this desirable end. The exodus of pulp and paper mills and of other wood-using industries from the Adirondack region and the availability of cheap Canadian pulpwood for the pulp mills that remained, have given it a "rest period", enabling the forest to recuperate from an era of large-scale utilization. This has gone so far that today the amount *used* falls far short of the amount *grown* in the private timberlands.

This is well exemplified by the decrease in pulpwood cut in the Adirondack region. In 1924 it was 244,747 cords. In 1928 (the latest year for which figures are available) it had dropped to 200,823 cords. In 1930, with the advent of Russian wood, it dropped still lower. But, placing it at 200,000 cords, this is less than the one-fifth of a cord per acre yearly growth on the eleven hundred thousand acres of forest land in larger private ownership. This growth of an average of one-fifth of a cord yearly has been verified for the Adirondack region by careful studies. In other words, the larger private lands are in effect on a basis of sustained yield or even better than that.

With notable exceptions, the larger private timberland owners in the Adirondacks have not engaged in large scale planting as a means of making their forests continuously productive. The natural reproduction is so abundant as to preclude the necessity for expensive artificial methods of reforestation.

The changing economic conditions have brought about an important change in the viewpoint of private timberland owners in the Adirondacks. Those owners that have determined to *hold* their land in perpetuity for commercial purposes, or as preserves, or as both (which is entirely feasible) have seen the wisdom of classifying their holdings so as to determine what parts are above the margin of profitable holding for timber growing and what parts are below this or, as it is called, "submarginal". This classification involves a careful survey of each owner's holdings in the light of present timber stands, forest types, growth, logging conditions and the like. This kind of work is well exemplified by the following classification outline used by one of the most progressive owners.[2]

*Best Lands*

E Hardwood type. Key trees, beech and rock maple.

[2]Finch, Pruyn & Co., Inc., of Glens Falls, N. Y.

E-1 Good present cut of pulpwood or good distribution of softwood from seedlings up to merchantable size, or both. Scattered groups (one-half acre or less) of good softwood reproduction or pulpwood.

E-2 Over story of hardwoods, beech, rock maple and yellow birch. Good stand of merchantable pulpwood or heavy spruce and balsam reproduction, or both. Land that can be girdled.

*Sub-Marginal M*

E-M-1 Mature old-growth hardwoods. No merchantable spruce and balsam pulpwood or reproduction. Clearly a hardwood producing country.

E-M-2 Second-growth hardwoods. Pure scattering spruce and balsam pulp and reproduction, too scattered for present or future lumbering. Result of very old burn, clearings or hardwood cuttings.

*Best Lands*

C Softwood flat. Natural softwood land.

C-1 Best flat. Good stand or excellent reproduction, or both. Little or no hardwoods. Well drained. Stand and reproduction indicates rapid growth.

C-2 Good flat. Fair stand or fair reproduction, or both. Hardwoods—but no beech or maple—scanty hardwood reproduction.

C-3 Same as C-2 but with more yellow birch. Can be benefited by girdling.

*Best Lands*

B Lower spruce slope.

B-1 Good stand of timber, or excellent reproduction, or both, little or no thrifty hardwoods. Ground, good. May be steep but not rough and broken.

B-2 Same as B-1, but with heavier stand of yellow birch. Can be benefited by girdling.

*Sub-Marginal M*

A Upper spruce slope.

A-M-1 Good present stand. Can be lumbered only with other timber. Will not stand alone.

A-M-2 Good present stand but too rough to lumber.

A-M-3 Poor present stand, has been lumbered with better ground (A-M-1). Generally heavy white birch reproduction.

A-M-4 Scrub.

*Best Lands*

D Softwood swamp.

D-1 Pure spruce and balsam swamp. Timber small but merchantable (over 6 inches d.b.h.) Excellent reproduction.

*Sub-Marginal M.*

D-M-1 Timbered but below merchantable size when mature.

D-M-2 Open bog.

D-M-3 Heavy stand of cedar; little spruce and balsam.

*Best Lands*

E-3 Mature poplar with good stand of small pulp or reproduction, or both. Old, light burn which is returning to softwood production.

*Sub-Marginal M*

E-M-3 Burns. Soil gone; pure waste land.

Areas which are submarginal but which control rights of way for logging roads, etc., to have X marked after key letters, example, E-M-3-X.

Time does not permit of going into the experimental work which some of the timberland owners have undertaken, but mention must be made of the very progressive conversion practice of one large owner, whereby certain hardwood areas are converted into the more valuable softwood stands, by girdling the generally defective and less desirable hardwoods that otherwise would dominate the area to the exclusion of spruce and balsam fir. Progress has also been made in the careful marking of all trees to be cut instead of relying on an arbitrary diameter limit. This is obviously a great advance in silvicultural practice.

To summarize, the larger private owners in the Adirondacks are keenly aware of the possibilities of making and keeping their timberlands fully productive. So far as economic conditions permit, they are handling their lands on a basis of continuous forest production; already the total growth is in excess of the total cut and will continue so, as long as cheap wood from the North and from overseas is available. There is, in short, every prospect of improved

timber growing practices on privately owned areas in the Adirondacks.

A. B. Recknagel,
*Cornell University.*

## Chaulmoogra Trees Bearing Fruit in Hawaii

The largest plantation of chaulmoogra oil trees in the world is located in the Waiahole Forest Reserve on the island of Oahu in the Territory of Hawaii. It consists of 2,000 trees of *Hydnocarpus anthelmintica* planted in 1921 and 250 trees of *Taraktogenos kurzii* planted in 1924. The former began to bear fruit in 1927 and the latter in 1930.

The trees are spaced 14 by 14 feet apart and are given special cultivation by harrowing in order to stimulate growth.

The seeds for starting this plantation were secured by the plant explorer, J. F. Rock, from Siam and Burma, respectively.

The fruit is the size of an orange and has a thick brown velvety shell which encloses about 30 closely-packed seeds, the size of peanuts. It is from these seeds that is expressed the chaulmoogra oil which, upon refinement, is used to alleviate leprosy.

As yet the crops of fruit in the Waiahole plantation have not been very heavy but it is expected that within a few years enough will be produced not only to supply local needs but to export to other places where the oil is needed.

C. S. Judd,
*Territorial Forester, Hawaii.*

## Relation of Forest Management to Water Resources[1]

At the May 7, 1930 meeting of the Hoover-Young Commission on Water Resources an opportunity was given to a group of foresters to present some data relating to forestry and water resources. The Commission was appointed jointly by President Hoover and Governor Young in 1929 for studying the conservation of water in California in its relations to federal and state interests. Dr. George C. Pardee, Chairman of the Commission, requested that the foresters submit any additional information pertinent to the subject. The chairman of the California Section of the Society, E. I. Kotok, aided by an executive committee, thereupon prepared and submitted the report that follows:

### Forest and Wild Lands as the Source of Water Supply in California

*Area*—Studies of the water resources of the state show that the bulk of the precipitation in California falls within the mountain and foothill region embraced in about 40,000,000 acres.

[1]A report to the Hoover-Young Commission on Water Resources, submitted by the California Section, Society of American Foresters, July 1, 1930.

TABLE 1

FORESTS AND WILD LANDS INCLUDED IN PRINCIPAL WATERSHEDS OF THE STATE

| Regions | Areas within national forests: National Forest ownership | Areas within national forests: Private holdings |
|---|---|---|
| | Area—acres | |
| Southern California | 3,013,118 | 575,230 |
| South coast | 320,374 | 91,261 |
| Southern Sierra | 4,712,142 | 1,125,000 |
| Northern Sierra | 4,195,052 | 1,750,000 |
| North and north coast | 6,941,078 | 1,357,731 |
| Total | 19,181,508 | 4,899,222 |

| Regions | Areas outside national forests |
|---|---|
| Southern California | 1,634,800 |
| South coast | 1,404,400 |
| North coast | 3,635,900 |
| Pine region | 7,433,840 |
| Total | 14,108,940 |

Included in this vast land area are the watersheds producing the main source of supply that must meet the needs of the State in any major coördinated plan of water development. These lands cannot be segregated from the precipitation falling upon them, and must both be considered together in the final analysis of a water resource plan.

*Character of cover of these lands.*—The forested lands consist chiefly of coniferous forests, the bulk of which are still virgin, but showing the effects of severely destructive fires to which they have been subjected in the past as well as to extensive exploitation by lumbering. Interspersed with these coniferous forests are extensive areas of brushfields, chaparral, and woodland which may, under proper management, be converted again into coniferous forest. On much of the cut-over coniferous forest, destructive logging and disastrous fires have so changed the character of the forest itself that heavy invasion of brushfields have taken place.

The foothills, are mainly covered by brushfields and chaparral, with a lesser amount of woodland and grassland. These foothills have suffered even more disastrously from fire, so that much of the former woodland type of tree-like hardwoods has been replaced by chaparral and brush. The evidence is abundant that since the occupation of California by the white man, the coniferous forests along the Sierra Nevada Mountains have been pushed back from 5 to 20 miles on the upper limits of the foothills, and the woodland type has been reduced to a mere fraction of its original importance and extent.

*Ownership.*—Approximately 24,000,000 acres are included within the boundaries of the national forests in this state, of which 79 per cent is in federal ownership. 12,000,000 acres, or about 50 per cent of this total area comprises the coniferous pine forests, the remainder are in woodland, chaparral brush, and alpine forest. The coniferous forests in the redwood region occupy almost 3,000,000 acres and are almost entirely in private ownership. The great bulk of the foothill region throughout the state lies outside of the national forests and is either in private ownership or in the public domain, not adequately administered.

Long-time plans of forest management and protection against fires are the guiding principles in the administration of national forest lands. Excepting for the compulsory patrol law, which applies only to forested lands within the pine region, there are no federal or state regulations prescribing what private

owners may or may not do on forest or foothill lands. Their use and management, at present, remains a legal right of the owner, frequently in conflict with the public interest.

### MANAGEMENT IN RELATIONSHIP TO THE WATER CROP

*General relationship.*—If the problem of designing and developing a water resource plan were only one of determining the areal distribution of precipitation and the amount of stream-flow, the answer could readily be given by the engineering profession without any further regard to the character of the ground cover and its treatment by man. The efforts of the American hydraulic engineers in contrast to universal European practice have been almost exclusively devoted, and quite properly so, to determining the amounts and intensity of waterflow in the major streams, ways and means of impounding and regulating the water supply, methods of conveyance, and means for its ultimate use and distribution.

Technical forestry cannot supplant these engineering phases of water conservation, but it can properly and effectively complement them. It has been shown, on the basis of present experimental data in California, continuing the experience in other countries, that the manner of treatment of the watersheds has an important bearing or the ultimate water crop. The kind and character of cover and the use or abuse to which it is subjected is intimately related to water production.

The condition of the land surface has a direct and significant influence on the amount of water absorbed and retained by the soil, on the time and rapidity of run-off, on the silt content of streams, and the velocity and turbidity of the water itself. It follows, since the form of land use affects the condition of the surface, it has an important bearing on the quantity and quality of run-off from that land. Land management, therefore, is the field in which the forester has an important duty to perform. Sound forestry plans must be developed so that watersheds can exert their optimum influence on the regulation of waterflow. Briefly, this will require protection of all of the watersheds against fire; reforestation or revegetation of critically denuded lands; and assurance that there will be proper methods of the harvesting of forage and timber crops even if control becomes necessary. This program should of necessity be supported by adequate research and investigations of ways and means for better handling of our forest and wild lands, and means of controlling erosion and of regulating streamflow.

*The federal obligation.*—With almost one-fifth of the land area of California under national forest administration and all lying within the principal watersheds of the state, it is obvious that the management of these lands must have the decisive rôle in the water crop. The federal obligation is stated as follows in the acts by which the national forests were created and set aside:

"For the purpose of securing favorable conditions of waterflows and to furnish a continuous supply of timber for the use and necessities of citizens of the United States."

This authorization is embodied in the Act of 1897. The same principle is

recognized in subsequent laws dealing with the national forests. Since the regions of heaviest precipitation lie largely within the national forests, their rational treatment becomes an inescapable obligation and responsibility of the federal government. There is every reason for California to take a strong interest in the development and management of its national forests.

*The state's obligation.*—The private holdings within the national forests, the 20,000,000 acres of foothills outside of and surrounding the national forests, and the redwood territory, excepting for lands within the public domain, stand outside of the jurisdiction and control of the federal government. Protection of these lands against fires, and the regulation of use of these lands as it may affect the water supply, are distinctly a state problem and a direct obligation of the state. This obligation has been in part recognized officially as early as 1889 by the creation of a state forest department, specifically charged with the protection of such lands from fire. In contrast to the federal administration of the national forests, the state has been confronted with difficult problems arising out of the fact that it is not an owner of the lands it must protect. With meager funds and, frequently, lukewarm public support, it has attempted to meet its obligation through educational means, endeavoring to create popular sentiment for the prevention and control of fires. Against heavy odds and by slow stages it has developed a skeleton machinery for fire protection purposes, covering the territory outside the national forests. It is safe to state that vastly enlarged state expenditures will be needed in order to carry out an adequate protection program. Some of the more prosperous counties in southern California have undertaken the protection of their watershed areas against fires on a far more extensive scale than that furnished by the state or even the federal government. It must be noted that the owners of forest and woodlands under state protection are not themselves the direct beneficiaries of the water crop developed from their lands. Frequently, occupancy and use in themselves may seriously impair the watershed values. This conflict in use and values must be weighed and judged in the light of the relative need for timber, forage, recreation, and water crop. Under sound forest management, such conflicts may be avoided and all of the inherent values of forest lands safely and wisely utilized. Ultimately, the state in its functions may have to go far beyond fire control and assume the larger regulatory responsibilities dealing with the use and occupancy of forest lands within important watersheds. All other civilized countries have arrived at the same solution.

*The obligation of the water using districts.*—The federal and state governments have distinct obligations in protecting watersheds against abuse. The water districts, as immediate beneficiaries, and in order to safeguard fully their own interests, have a distinct and direct responsibility. Their interest must go far beyond dams, reservoirs, canals, and conduits. It must embrace the watershed as the very source of the water. Where difficulties and conflicts in the use of watersheds arise and where the water values are high, it may be

necessary for the state and the water districts coöperatively to acquire such lands outside of federal ownership and secure full authority and control in their management. By this expedient a relatively small outlay for land will insure and safeguard enormous investments in engineering.

A large area of land outside of the national forests possessing watershed value lies in the public domain owned by the United States, but as yet unmanaged in any way. Most of these lands are in effect a public common, subject to unlimited and unrestricted use and abuse. This situation is in the long run obviously intolerable and the placing of the public domain outside of national forests or parks under effective public management is an immediate need of the water conservation problem in California.

## PRELIMINARY EXPERIMENTAL RESULTS INDICATING THE RELATIONSHIP OF THE VEGETATIVE MANTLE ON RUN-OFF AND EROSION

After several centuries of forest management in France, Germany, Switzerland, Austria, and Italy, the principle is universally recognized that a complete natural mantle of forest, brush, or certain types of herbaceous vegetation produces maximum regulation of run-off and reduces erosion to a negligible degree. All of these countries possess an elaborate system of protection forests in mountainous regions established to accomplish these purposes.

It has been found in limited experiments in California that the removal or destruction of the vegetative cover exposes the land surface to the full forces of erosion by reducing the absorptive capacity of the soil and by increasing surface run-off, thus accelerating the process of erosion to a marked degree. Even these preliminary studies and observations are sufficiently decisive to show that such effects are operating on a large scale in the watersheds in California. The evaluation of the true trend and magnitude of these processes forms an integral part of the basis for the shaping of water-management policies. In contrast to more humid regions, California is confronted with a series of special problems complicated by fluctuating annual precipitation concentrated in a short period of intense rainfall, by steep topography, by short drainages and natural detrital-filled storage basins in the valleys.

Three predominating forces are at play in the mountain and foothill regions of California which disturb and modify the natural vegetative cover: namely, fire, grazing, and lumbering. Frequently these three influences exist simultaneously or follow each other closely in a given area. Each of these influences has its own characteristic effect on the vegetation and requires, in turn, its own special study.

*The effect of fire on water relationship.*—Hot, dry summers favor intense and widespread burns which leave watershed surfaces bare and ashy, exposed to the full effects of the torrential wash of fall and winter rains. Preliminary results reported by Munns in response to Senate Concurrent Resolution No. 27, in the Legislature of 1921, give abundant evidence of the enormously accelerated erosion which follows fires on

various California watersheds. Studies by Show and Kotok show the serious disturbances that follow in the forest itself after fires, and the degree to which the California pine region has been subjected to this influence in the past. More recent and detailed experimental work by Lowdermilk proves that complete destruction of the vegetative cover and the ground litter by fire increases surface run-off 15 to 20 times, and the removal of eroded material 100 to 1,000 times. Intensities of rainfall of 1.0 inches per hour over a ten minute period, accelerates tremendously the immediate surface run-off and erosion on freshly burned over land. These significant studies can be considered only a beginning in the systematic attack on this problem. Lowdermilk's findings have been reported more fully to the Commission.

*The effect of grazing on this relationship.*—The relation of grazing to streamflow and erosion has been studied only in the most premilimary way in California by Munns. Intensive studies by Sampson, Forsling, and others, in the Great Basin Region in Utah are of some indicative value to our own problem. In one of their studies, two comparable watersheds of approximately the same size, elevation, and soil, were grazed to different intensities, from 1915 to 1929, inclusive. Watershed "A" had its plant cover maintained at 16 per cent of the possible fully stocked ground cover for five years and then increased to 40 per cent, being carried at that density through the remainder of the experiment. Watershed "B" was maintained at a 40 per cent plant cover throughout the entire period. Watershed "B" shows for the entire period 64 per cent less in surface run-off and 54 per cent less sediment than does watershed "A" from summer rains. With an increase in cover on watershed "A" the amount of sediment carried on each 1,000 cubic foot of winter run-off was reduced 53 per cent. These studies also show that watersheds, depleted of herbaceous vegetation by over-grazing, produce a system of gullies which are directly instrumental in accelerating run-off and erosion.

Preliminary investigations conducted in the watersheds feeding the Roosevelt and Coolidge reservoirs indicate a serious erosion problem as the result of intense grazing by livestock. Check areas show a removal in some instances of one-half inch of soil in seven and one-half months of 1928. Some check stations on steep slopes below scant vegetation show as much as 0.2 feet erosion in two and a half years.

The need for intensive studies of the effect of grazing on California watersheds is evident in the light of the results found in other western regions.

*The effect of lumbering on this relationship.*—Methods of logging employed in Calfiornia vary all the way from complete denudation on some private lands to the most careful silvicultural systems in use by the national forests. The intensity of cutting and the mechanical means employed in removing the timber, without any doubt, affect streamflow, surface run-off and erosion to varying degrees. Where broadcast fires are permitted to run uncontrolled through slash and debris left after logging, the watershed values are impaired to an even greater degree than through destructive fires in virgin timber stands.

It should be noted that more recent cutting on some private lands are leaving a more effective cover than heretofore.

The effect of lumbering itself on run-off, seepage, and erosion, has not been studied experimentally and requires systematic investigation at an early date. With the great proportion of our forests still virgin and waiting for the axe, it is imperative to know in advance how cutting in its various methods and aspects will affect the water crop. Intensive studies undertaken on a broad and intensive scale form one of the most urgent and important parts of the California forest research program.

### CONTRIBUTION BY FORESTERS THROUGH RESEARCH TO WATER RESOURCE DEVELOPMENT FOR CALIFORNIA

*Determination of the relative values of various vegetative covers in water conservation.*—The wide latitudinal range occupied by the state and the differences in altitude produce great extremes in climatic zones characterized by most complex plant associations. In a very simple classification of plant life adopted by the California Forest Experiment Station for the preparation of a cover-type map of the state, more than 50 definable and recognizable types were used. If sub-types were to be considered, the number would run well into the thousands. All types of vegetation on a watershed function alike in that they all build and hold the soil, increase the absorptive capacity of the soil profile, retard immediate surface run-off, and return to the air through evaporation and transpiration vast quantities of moisture. Plants, however, vary materially in their structure, their requirements for moisture, their capacity for absorption and transpiration, and their ability to penetrate the soil in their search for water. The density of the vegetation also has an important bearing on the water cycle.

The individual plant is of little significance in the watershed. It is the association of plants in large numbers that governs the relationship of vegetation to water. The major types and sub-types of vegetation, their age and condition, their height and density, are important and can be made the object of the study on their affect on run-off, seepage, and transpiration. While the vegetative mantle has distinctive values for forage and timber, some types are more desirable than others for these purposes, but may have, however, a different value bearing on the water crop. The problems that the forester must answer from the standpoint of water conservation are: Which type of vegetation will make available the greatest amount of water while allowing least erosion? This involves comprehensive studies of transpiration and evaporation from various types of vegetation, an almost unexplored field of study.

*Forms of forest management and the maintenance of maximum water values;* and

*Need for further and complete studies of effects of grazing, lumbering, and fire on the water yield.*—Grazing and timber harvesting and the manner in which they are accomplished produce significant changes resulting in sequences in the cover types and consequently change the water yield in any given watershed. If

these uses are permitted to go on unregulated and uncontrolled, we find that the density of the cover type is so much reduced that the water cycle is perceptibly affected. Under rational forest management the harvest of forage and timber can be effectively controlled and may even make possible increases in the water yield. In this connection it is the objective of forest research to determine the value of the natural vegetative mantle on the ground and how forest management maintains it or converts it into a more desirable cover. To accomplish this, as indicated previously, complete studies in each of the important types and subtypes must be made of the effects of fire, grazing, and lumbering and on their modification of run-off, regulation of streamflow, and erosion. Obviously, such studies must run parallel to the determination of the best forms of forest management for the production of forage or timber.

*Determination of the basic factors affecting water supply for use by hydraulic engineers.*—The factors that an engineer considers in determining the value of a watershed are the amount of precipitation, the amount, intensity and regularity of streamflow, and the quantity of sediment carried in the streams. This is merely a water-yield estimate for a given watershed under existing conditions. The forester, on the other hand, must furnish the information to show how this water-yield will be affected by changes in the cover-type under various systems of land management.

Reservoirs with large capital investment have been built in the past without due degard to the possibility of the reduction of their capacity through abnormal and avoidable silting. This condition may repeat itself. One of the simplest methods for the reduction of erosion and for holding of the soil in place consists in the maintenance of suitable vegetation and planting of eroded areas. This again is a purely technical forestry problem, and for California will involve studies in the best methods of meeting such contingencies.

## SUMMARY AND RECOMMENDATIONS

1.—The protection and development of the mountain and foothill territories of California, embracing the major watersheds, are entrusted, under present federal and state laws, to the U. S. Forest Service in the Department of Agriculture and the state forest service in the Department of Natural Resources. Through enabling acts a number of counties have perfected their own organizations charged with similar functions. It has already been brought out that the manner in which these lands are treated has a direct bearing on the character of water yield from a given watershed. Obviously, the forester, in his work of producing forage or timber crops, in the methods he employs in their harvesting, in the manner and degree in which he maintains or disturbs the natural mantle of vegetation and in the intensity of the fire protection he furnishes, may enhance or decrease the water yield on any given watershed.

The forester must coördinate his policies in the development of all of the values that the forest produce, stressing in this state the water crop. As long as water forms an all important product of our forest lands no far sighted or

intelligent planning for water or even forest management is possible unless the technical forester with his knowledge of the intimate dependence of water on vegetation takes an active and integral part in the formulation of a comprehensive water resource plan for California. Many state and federal commissions and boards have been created in the past to study the water problem of the state, but no place has been given on them to trained and qualified foresters. This has left out a group of men who will be charged ultimately with the development and protection of the watersheds and yet find themselves with no voice in the determination of measures essential to the safeguarding of the water crop itself. Important as are the financial and engineering phases of water conservation, it cannot be overlooked that certain vital problems lie not within the scope of engineering but within that of technical forestry. To this end, the professional foresters of California urge that your Commission recommend that future boards and commissions on water conservation include in their roster technical and qualified foresters. The California Section of the Society of American Foresters would be glad to be of assistance in the choice of properly qualified men.

2.—Fire continues to be the outstanding threat to California's watersheds. All the evidence so far adduced conclusively proves that fire detrimentally affects seepage, surface run-off, and stabilization of the soil. This relationship may vary quantitatviely for different climatic or forest conditions, but, nevertheless, exists on all watersheds. It is no longer a mooted question what fires will do.

TABLE 2

FOREST AND BRUSH FIRES IN CALIFORNIA TOTALS (1928-1929)

| Causes | Number fires | Number acres burned | Damage in dollars |
|---|---|---|---|
| Lightning | 1,073 | 167,470 | $ 133,460 |
| Railroad | 283 | 330,442 | 358,075 |
| Campers | 393 | 95,699 | 97,187 |
| Smokers | 2,375 | 697,936 | 1,713,385 |
| Debris burning | 711 | 137,565 | 297,066 |
| Incendiary | 1,169 | 1,081,639 | 1,522,349 |
| Lumbering | 266 | 13,329 | 48,064 |
| Miscellaneous | 845 | 234,459 | 904,297 |
| Total | 7,014 | 2,361,539 | $5,116,288 |

In Table 2 is given the total number of brush and timber fires that occurred in the watershed areas under consideration for the period 1928-1929. A total of over 7,000 fires with over 2,300,000 acres burned and an estimate of at least $5,000,000 damage, not including cost for fire fighting—these are staggering figures. Experimental plots on the Sierra foothills show that in 1929, with 18 inches of precipitation, about four cubic yards of dirt was washed off from burned-over areas, whereas the unburned plots had the barest trace of detrital material removed. If even the conservative figure of two cubic yards of soil removal per acre were applied to an acreage of 2,361,539 burnedlover land, we get an enormous yardage of dirt moved down from the watershed, which, ultimately, must reach the important drainage and storage basins.

From the standpoint of the forester it is inconceivable how tremendous outlays for water development can be planned without immediate provision for a most complete system of protec-

tion against fires. Indisputable records of the past two decades show that fire protection, inside or outside of the national forests, is inadequate. In view of this critical situation, the foresters of California urge your Commission to recommend that, as a corollary to the safeguarding of the investments proposed for water development, the federal government provide truly adequate funds for the prevention and protection from fires on the national forests, and that the state and local governments provide similarly for all watersheds outside the national forests. Both the federal and state forest services have already prepared detailed programs for carrying out such an enlarged plan of fire control and merely await additional funds for carrying them into effect.

3.—Forest research on the relationship of forests and water in California is being carried on by two agencies—the California Forest Experiment Station and the Division of Forestry of the University of California. These two agencies are in closest coöperation, being housed in the same buildings, frequently pooling their interests, and having a definite plan for the coördination and correlation of work. The California Forest Experiment Station, a branch of the research organization of the U. S. Forest Service, is financed by federal with the aid of state and county funds. A statement of its budget is attached. The Division of Forestry is financed by state appropriations through the university budget. Appropriations so far for both branches have been inadequate for any comprehensive program of research dealing with the increasingly complex problems of the relationship of forests and water. There exists a distinct federal and state obligation to forward this work with greater rapidity than in the past. The total expenditures of the California Station in this particular field are at present about $15,000, contributed by federal, state, and county agencies. The current appropriations for the Division of Forestry in this field are $2,500. The Experiment Station and the Division of Forestry together should have at least $100,000 annually for this field of work.

The California Section of the Society of American Foresters urges that your commission use its good offices in bringing before the proper authorities the need for rapidly expanding research on the problems of water and forests by the two agencies that have already initiated work in this field. Specifically, we would suggest the following lines of action:

*a.* Recommendations to the Director of the Budget, the Secretary of Agriculture, and the Chief Forester of the U. S. Forest Service that an appropriation of $50,000 be made to the California Forest Experiment Station for financing research dealing with the effects of forests on run-off, seepage, and erosion. Under an item carried by the appropriations of the Bureau of Chemistry and Soils, $5,000 has already been appropriated for work on erosion in California. The budget for the next fiscal year is now being prepared and considered by the Secretary of Agriculture and prompt action by your commission would be of material assistance.

*b.* With a contemplated expenditure of over one-half billion dollars for water development in California, the Cali-

fornia Section of the Society of American Foresters believes that at least a tenth of one per cent of such appropriations can well be devoted to forest research dealing with this problem. Industry frequently sets aside sums ranging from one to five per cent for research. Since the budget of the State Division of Forestry is intended primarily for forest fire protection and is entirely inadequate even for that purpose, no contributions by it toward this work seem desirable. The more expedient means would be to provide specially for research from appropriations made for water development. If at present $50,000 were provided from such funds and under such a plan for research work in conjunction with increases to be hoped for from federal sources, a reasonably expanded program could be undertaken both by the California Forest Experiment Station and the Division of Forestry of the University of California.

*c.* There is need for developing men trained for this special field of work for California. To accomplish this, increased facilities for teaching are urgently needed in the Division of Forestery of the University of California. The California Section of the Society of American Foresters urges that this matter be called to the attention of the President and the Board of Regents of the University of California.

## Compound Interest in Forestry

Compound interest is often referred to as the principal stumbling block to the practice of industrial forestry. The idea that it has been overdone is rather generally appreciated now, and we find that those organizations who are adopting the policy of managing their lands for future crops give no consideration to compound interest. In an article in the January, 1931, Journal of Forestry, by A. E. Wackermann, in which he describes the management of the lands of a large southern lumber company, he says, "Compound interest plays no havoc with this operation because it does not apply". In an interview in the October 1930 issue of *The Timberman,* entitled "Swedish Forester Visits Pacific Coast" a Swedish forester says: "The theory of compound interest in growing timber is not considered sound in Sweden".

In this number of the Journal appears an article by Axel Oxholm giving the Swedish point of view. In Sweden the maintenance of forests in productive condition is not optional with the timberland owner: it is compulsory. If compound interest would be a factor in the owner's investment in Sweden, he would certainly relinquish the land to the government and invest his money elsewhere. Private effort in Sweden appears to be accepted and successful.

Because of its clarity in stating the compound interest fallacy, there is also reprinted in full an article by the Hon. Nigel A. Orde-Powlett entitled "Capital and Interest", which appeared in the *Quarterly Journal of Forestry* of London.

E. F.

## The Attitude of Sweden Toward Compound Interest in Forestry Calculations

At a recent economic conference a mathematician made the surprising statement that the investment of $5,000 in Columbus' expedition (representing its total cost) was an unprofitable one since, with compound interest, this investment of $5,000 in 1492 would today represent a sum of money considerably in excess of the total national wealth of the United States. While this statement from the point of view of the mathematician can not be challenged, yet no one would contend that the discovery of America and its subsequent development have resulted in economic failure.

The question of compound interest always looms up as a barrier to the commercial growing of forests, not least in this country. It is even considered a greater hindrance to the development of new forests than the risk of fire and insect attack. But, compound interest is not a new factor with which to reckon in the practice of forestry. It may, therefore, be of interest briefly to review the consideration which has been given this matter by Sweden for instance, which stands today as the most conspicuous example of a country which has successfully perpetuated its forest resources.

For centuries past, leading Swedish statesmen have advocated the maintenance of productive forests as a national necessity. In fact, the very existence of the country depends on the maintenance of adequate forest resources. This is not only based on the fact that the key industries of the country are closely tied up with the forests, but large sections of the country can not be profitably used for agriculture on account of unfavorable climatic and soil conditions. If the timber is removed from these lands, they will remain barren, uninhabited wastes.

The maintenance of productive forests in Sweden is taken as a matter of course, not only by the statesmen and law-makers but also by the forest owners and the public at large. Therefore, no expense is spared to further this program. The government as well as private timber land owners are spending millions of dollars every year on the planting of new forests, on combating fire and insect attack, on the construction of logging roads and their maintenance, on constant improvements in making the rivers more suitable for log-driving, and yet, climatic and soil conditions are not particularly favorable to tree growth compared with these conditions in most parts of the United States.

The predominant species in Sweden are pine and spruce. It requires from 70 to 150 years to grow a tree to saw-log size in that country, and yet no one will dispute the fact that forestry has been a commercial success in Sweden. Were this not so, the forestry regulations concerning the maintenance of timber land in productive conditions would be unpopular, and would eventually drive the timber owner to ruin. The government would eventually be the sole owner of the forests in that country.

If the raising of forests on a 30- to 40-year rotation basis in this country is by many considered an economic failure, then there would seem to be little hope

for reforestation in Sweden. The arguments which support Swedish reforestation activities are in the main as follows:

1. The forests and the forest industries are the backbone of the country.

2. The financial position of the forest industries is largely judged by their forest resources, and not by their plants alone.

3. The maintenance of an adequate labor supply with particular reference to skilled labor, is not possible unless the wood conversion plants can operate on a long-term basis. As a matter of fact, nearly all Swedish wood conversion plants are now on a perpetual basis of operation, due to provisions made for an adequate supply of timber.

4. By law, wood lots can not be separated from the farm—a wood lot is the farmer's savings bank, and in case of crop failure the wood lots would carry him over the hard times.

5. The government feels that it is justified in expending money on the reforestation enterprises, improvement of transportation system in connection with logging and lumbering, in carrying out forestry research, and in short, in lending financial aid to the development of the forests of the country, because the forest industries and the people employed in these industries contribute the bulk of the country's taxes.

6. The transportation of forest products constitutes an important income for the Swedish government railways. It also supports the maintenance of an important merchant marine. Swedish steamers carrying forest products to foreign markets bring back foreign products needed in Sweden at low freight charges, thereby effecting an appreciable saving on the nation's freight bill.

To sum it up, the question of compound interest, while naturally considered, is by no means the deciding factor in determining the Swedish forest policy. The indirect benefits such as the employment of thousands of hands, the stabilization of the wood conversion and allied industries, the important tax revenue derived from forestry operations, and many other factors have brought about a determined effort on the part of the nation as a whole that its forests shall be maintained forever in productive condition; therefore, the annual cut and the annual consumption of wood are balanced.

A hundred years ago one of Sweden's leading statesmen said "The position of Sweden as an independent country and as a civilized nation depends on the maintenance of her forests in a productive condition." It is a fact that Sweden is one of the few countries in the world today which enjoy a real prosperity and stabilized industrial conditions. Everyone agrees that the high development of the nation's wood-using industries backed up by abundant forest resources, is largely responsible for these satisfactory conditions.

Under these conditions it is easily understood that the question of compound interest plays a minor part.

Axel H. Oxholm,
*Director, National Committee on Wood Utilization.*

## A Money Analogy for Remembering Basis of Moisture Content

From Trade Circular No. 2 of the Division of Forest Products, Melbourne, Australia, entitled *The Testing of Timber for Moisture Content,* is taken the following useful analogy: "A useful method of remembering the way to express moisture as a percentage is by a money analogy. In money problems, "Interest" is expressed as a percentage of the "Principal", and the sum of interest and principal is the "Amount". Now, the total weight of a sample of wood can be likened to the Amount, the oven dry weight is the Principal, and the moisture content is the Interest. So, as the Interest is expressed as a percentage of the Principal, not of the Amount, moisture content is expressed as a percentage of the oven dry weight, not of the total weight. Thus:

Principal + Interest = Amount.
Oven dry weight + Water present = Total weight.

$$\text{Percentage Interest} = \frac{\text{Interest}}{\text{Principal}} \times 100.$$

$$\text{Percentage moisture content} = \frac{\text{Water present}}{\text{Oven dry weight}} \times 100.$$

## The Importance of Organizing Small Mills in the South

There are nearly 7,000 small sawmills in the pine region of the South, ranging from the smallest to an annual capacity of 6,000,000 board feet, according to H. C. Berckes, secretary-manager of the Southern Pine Association in an interview appearing in the *American Lumberman* of November 29, 1930. These mills cut 51 per cent of the total annual pine production and their output is worth $100,000,000. There are 239 large mills. Table 1 gives the production of the mills by states:

Table 1

SMALL AND LARGE MILL PRODUCTION IN 1929

| | Production M. feet | Number mills |
|---|---|---|
| *Alabama* | | |
| Small mills | 1,509,985 | 1,912 |
| Large mills | 722,000 | 40 |
| *Arkansas* | | |
| Small mills | 395,610 | 375 |
| Large mills | 389,000 | 14 |
| *Florida* | | |
| Small mills | 386,375 | 337 |
| Large mills | 684,950 | 40 |
| *Georgia* | | |
| Small mills | 1,050,035 | 1,376 |
| Large mills | 109,800 | 9 |
| *Louisiana* | | |
| Small mills | 228,820 | 114 |
| Large mills | 955,500 | 38 |
| *Mississippi* | | |
| Small mills | 917,980 | 1,081 |
| Large mills | 1,446,200 | 53 |
| *North Carolina* | | |
| Small mills | 773,890 | 550 |
| Large mills | 274,000 | ..... |
| *Oklahoma* | | |
| Small mills | 78,100 | 78 |
| Large mills | 103,000 | 4 |
| *South Carolina* | | |
| Small mills | 821,900 | 345 |
| Large mills | 432,000 | ..... |
| *Texas* | | |
| Small mills | 347,285 | 316 |
| Large mills | 959,000 | 41 |
| *Virginia* | | |
| Small mills | 427,000 | 367 |
| Large mills | 104,000 | ..... |

Total, 6,851 small mills cutting 6,936,980,000 feet and 239 large mills cutting 6,179,450,000 feet.

That the small mill is rapidly coming to be a dominant factor in the South is indicated by the effort of the Southern Pine Association to bring the small mills into its membership. Association membership should offer many benefits

to the small producers. Their product, now poorly manufactured and graded, can be given association, supervision, and standardization, thus giving it a greater market value. The services of association logging, milling, grading and marketing experts become available and make it possible for the small man to learn of economies. The services of the association in traffic and rate matters should alone repay the cost of membership.

The Southern Pine Association is the most experienced lumber trade association in the country, and it has been a pioneer in many lumber activities. Now that the large mill is rapidly coming to be a thing of the past and the small mill is taking its place, it gives the small operator the benefit of services built up by larger operators at a cost of millions of dollars. Membership, which costs large operators fifteen cents a thousand feet of production, is being offered the small men at five cents a thousand feet cut and shipped.

The small mills deserve more attention on the part of government forest products engineers than the large mills ever received. The latter could hire the best men; the former will create havoc with second-growth stands unless they can be organized and given technical advice and supervision.

E. F.

## The Swedish National Forest Survey

In a preliminary report entitled "Sweden's Forest Resources", just published in Stockholm, appears a brief description of the method used in making that country's national forest survey. In view of the nation-wide survey being made in the United States at the present time by the U. S. Forest Service, this description is of particular interest and is therefore reproduced here in full. The tables mentioned are however not reproduced; they include: 1. The area of productive forest land and bog; 2. number of trees, at least 4 and 8 inches d.b.h. and the number of conifers in different diameter classes; 3. total supply of timber by diameter classes; 4. total supply of conifers by age classes; and, 5. aggregate annual growth. The full report is to be ready for distribution before the close of 1932.

The description of the Swedish survey follows:

In 1907 a Swedish forester proposed that the old Swedish linear or strip survey method should be employed in the investigation of large forest areas. The mathematical reliability of the linear survey method was looked into and it was found that this method might be expected to yield fully satisfactory results at a reasonable cost. Subsequently the method was further developed and tested by a trial forest survey of the entire province of Värmland, in Central Sweden, in 1911. As the results of this inventory, which were published *in toto* in 1914, were found fully to satisfy all demands as to accuracy that had been required of them, the Commission responsible for carrying out the trial survey was able also to outline a scheme for taking stock of the forests throughout the entire country.

The immediate realization of this plan

was, however, prevented by the War and the critical years of peace that followed, so that it was not until 1923-1929 that the Swedish national forest inventory could be made. In the course of this survey both state and privately owned forests have been investigated in conformity with the method used in 1911, which, however, in regard to certain details was further improved in 1923 by specially appointed experts. In applying the line survey method to the Swedish national forest inventory the following procedure was adopted: within a 33-foot (10-meter) wide strip along a system of survey lines all trees, with the exception of those of the smallest dimensions, were measured and counted and at the same time the area was classified as arable or forestland, pasture, bog, rock outcrop, garden, or road, etc. Productive forest land was subdivided and classified according to productivity and the different forest types. These survey lines were, for the most part, drawn at right angles to the main topographical direction, and the distance between them, which was determined on the basis of the results obtained as to reliability in the trial survey carried out in 1911, has varied from 12.4 miles (= 20 km.) in the two most northerly provinces of Sweden to 0.62 miles (= 1 km.) in the country's southernmost province. For the purposes of the survey, a certain previously fixed number of the recorded trees of each species and diameter class was automatically, that is to say without selection, taken out as sample trees. These have been subjected to a thorough investigation in regard to height, taper, cubic volume and increment, as well as to age and defects, etc., besides which, a note has been made of the distance of the sample trees from the drag-rope that marked the center-line of the 33-foot (10-meter) belt. The last-mentioned observation has rendered it possible to follow the method worked out for the Norwegian national forest survey of checking the width of the survey strip.

The average number of persons employed in the field-work each summer has been over 100, and in the office 15 persons during the summer and 20 persons during the winter of each year. Each surveying party consisted of a leader and 8-10 men. Foresters possessing a higher forestry training have acted as leaders, and, moreover, the work of the surveying parties has been controlled by a supervisor.

Of the total land area of Sweden, which amounts to 101 million acres (= 41 mill. hectares), the productive forest land comprises 57 mill. acres (= 23 mill. hectares). In the productive forest area are not included broadleaf forests above the coniferous timberline or other forests of poor growth, *i.e.*, forest land with a yearly wood producing capacity of less than 14.3 cubic feet per acre. In the course of the forest survey a belt of 32,300 miles (= 52,000 km.) in length and a total of 180,000 sample trees were investigated. By the time the most important results for the whole country had come to hand, the inventory had involved an expenditure of $327,000 (= 1,220,000 Kronor), which is equivalent to 0.57 cents per acre of productive forest land (= 5¼ öre per hectare of productive forest land).

The compilation of the statistics has been carried out partly according to provinces, partly also, in northern and

central Sweden, using as units, areas at different elevation and watersheds. The results of the survey of the entire country were first available in December 1929. The calculations made to ascertain their reliability have shown that the sample method adopted for the purposes of the national forest survey reaches a high standard of accuracy. It may safely be claimed that the results for the entire country in regard both to area of productive forest land and to cubic volume and increment, in a degree of probability bordering on certainty, cannot show at most more than 2 per cent divergence from the results one would have obtained had the entire country been covered with survey strips 33 feet (10 meters) wide and the same methods of procedure been used.

The results of the national forest survey have been published in detail in the journal *Skogen* (*The Forest*) during 1927-1930, while some of the most vital have been incorporated in the 1930 number of Statistisk Arsbok för Sverige (Statistical Year Book for Sweden), out of which the following tables[1] have been taken. All that need be added to the figures quoted in these tables is the comment that the national forest survey has shown that not only is Sweden's supply of timber greater than, but its annual growth during the immediately preceding 10 years has far exceeded, even the boldest earlier estimate. The total volume of wood (peeled) in the forests of Sweden is, according to the survey, 50,062 million cubic feet (=1,417 mill. cubic meters) and the annual increment (peeled volume) amounts to 1,683 million cubic feet (= 47.7 mill. cubic meters). If the bark volume is included, the total supply will amount to approximately 60,000 million cubic feet (= 1,700 mill. cubic meters) and the annual increment to approximately 2,000 million cubic feet (= 57 mill. cubic meters).

The area that was the subject of a trial survey in 1911, the province of Värmland, showed upon being re-surveyed in 1929 considerable improvement in the condition of its forests, with a substantial increase in both cubic volume and growth.

It is estimated that the full report will be ready during the period 1931-1932, and interested persons desirous of obtaining particulars as to working methods, special investigations, etc., are referred to that report.

[1]See introductory paragraph.

## Mexico Proposes Establishment of Forestry Experiment Stations

In an address before the First Mexican Forestry Congress, Forester Ricardo Rodrieguez Munoz pointed out the necessity of the Government establishing several experiment stations. These stations, Senor Munoz stated, would be charged with the study of the technical forestry problems in the regions in which they would be established.

The need for the experiment stations has been brought about by the lack of information in problems which are of vital interest to the nation. Moreover,

if uniform practices are to be obtained, studies must be carried on to determine the policy to be followed.

The stations would be composed of sections, such as geology, topography, botany, silviculture and reforestation, and statistics. At the head of each section would be a chief, who would make monthly progress reports to the director of the station. The director, in turn, would make an annual report to the Secretary of Agriculture.

Señor Munoz concluded his address by recommending the establishment of two experiment stations, one in the tropical forests and one in the temperate forest zone. (From *Mexico Forestal.*)

A. N. Weber,
*El Dorado National Forest.*

## Society of Mexican Foresters Acts to Save Historic Tree

On the beach of La Antigua, north of Vera Cruz, there stands a magnificent Ceiba tree (*Bombax ceiba*). It was under the sheltering and shady branches of this tree that the famous "Conquistador" Hernando Cortes first set foot on Mexican soil. Because of its historical importance the Society of Mexican Foresters has taken steps to have this tree set aside as a historical monument. (From *Mexico Forestal.*)

A. N. Weber,
*El Dorado National Forest.*

## Civil Service Examinations

Announcement is made by the United States Civil Service Commission that applications for examinations for the grades of Forest Ecologist, Senior Forest Ecologist, Associate Forest Ecologist and Assistant Forest Ecologist must be on file at Washington, D. C., not later than March 18, 1931. Competitors will not be required to report for examination at any place, but will be rated on their education, training, experience, and fitness and on their writing.

Details concerning salary range, qualifications, and the like may be obtained from the United States Civil Service Commission, Washington, D. C., or from the Secretary of the United States Civil Service, Board of Examiners, at the post office or courthouse in any city.

# SOCIETY AFFAIRS

## G. Frederick Schwarz
## 1868-1931

The death of G. Frederick Schwarz, of New York, on January 1, 1931, at Brewster, Cape Cod, Massachusetts, takes from the ranks of American foresters one of the small group who made up the old Division of Forestry of the U. S. Department of Agriculture in the years immediately following the appointment of Mr. Gifford Pinchot as Forester.

Although personally known, probably, to but few of the younger men in the profession today,—notwithstanding that for twenty years he was a senior member of the Society of American Foresters,—Schwarz held a unique place in American forestry. He was the first exponent in the United States of the conception that forest aesthetics has a definite place in forestry. That this idea continued to actuate him throughout his life is evidenced by his sustained interest in, and his efforts to bring to fruition one project after another that had to do with safeguarding and perpetuating forest stands of unusual interest or beauty. He was not afraid at a time when this doctrine had few other supporters, to champion the thesis that beauty in a forest is an asset not to be overlooked. The contributions that he made to a better understanding of this aspect of forestry will be increasingly appreciated in years to come.

George Frederick Schwarz was born in Baltimore, Md., April 13, 1868. He was a son of the late Frederick A. O. Schwarz,—for many years the head of New York's leading toy firm on Fifth Avenue,—and of Caroline (Clausen) Schwarz. Having attended private schools in New York City he pursued for two years, 1886-1888, the technical course at the Royal Textile School in Crefeld, Germany. With this training he conducted for a time a silk factory in Paterson, New Jersey. But commercial pursuits were not to his taste and in 1891 he enrolled as a student in Harvard University. Until 1894 he was in Harvard College and then, for a few months, in the Harvard Law School. His studies at Harvard were concentrated on languages, literature and the natural sciences.

He then went to Europe and for two years studied in the German forest schools at Hohenheim and Münden and in the French National Forest School in Nancy. At this time he saw many German and French forests and in later years, as parts of other trips to Europe, visited the forests of other of the continental countries and of Great Britain. In 1904-05 he was again for a time at Harvard, investigating the subject of aesthetics in its relation to the scenic value of woodlands.

In 1899 Schwarz entered the Divi-

G. Frederick Schwarz
1868-1931

ALFRED KNIGHT CHITTENDEN
1879-1930
*For obituary notice see Journal of Forestry, February 1931*

JOHN W. STEPHEN
1863-1931

sion, later the Bureau of Forestry in the U. S. Department of Agriculture, now the Forest Service, serving first as Field Assistant, later as Expert. His assignments took him to various parts of the country. Part of his work had to do with studies of the influence of forests on stream flow, including one that was then being conducted in the San Bernardino Mountains of Southern California, under the direction of Prof. J. W. Toumey. While with the government Mr. Schwarz wrote a bulletin (No. 44, old series) *"The Diminished Flow of the Rock River in Wisconsin and Illinois, with its Relation to the Surrounding Forests,"* 1903.

After 1904, for almost twenty years, Schwarz practiced intermittently as a consulting forester, with headquarters first in Boston, later in New York. Having independent means he travelled extensively and devoted much of his time during these years to helping to advance movements involving forests and forest parks that have as their objectives the perpetuation of the larger scenic aspects of the locality. He retired from active participation in forestry matters seven or eight years ago, at which time, 1922, he resigned from the Society of American Foresters, of which he had been a senior member since February 2, 1902. Very fond of Cape Cod, he lived for a time during the past decade in Dennis, where he gave tangible expression to some of his ideas by creating a perfect setting for the skillfully remodeled old farm house that was his home. In New York he had an apartment in Bronxville. Mr. Schwarz never married.

Deeply impressed while still a student by the book *"Forst Asthetik,"* written by the European authority on this subject, Heinrich von Salisch, an Austrian, Mr. Schwarz's chief interest ever centered on those aspects of forestry that relate to the scenic value of forests and woodlands. In 1901 he published his *"Forest Trees and Forest Scenery,"* (The Grafton Press, New York) and in 1907 *"The Longleaf Pine in Virgin Forest"* (John Wiley & Sons, New York). The final chapter of the latter book is a brief exposition of forest aesthetics. Mr. Schwarz was a member of the Appalachian Mountain Club of Boston and of the Sierra Club of California, of the Authors' Club of London, the Cosmos Club of Washington, and the Harvard Clubs of Boston and New York. For several years he was a director of the Society for the Preservation of National Parks.

Schwarz was greatly interested in and concerned with the controversy over the use of the Hetch-Hetchy Valley in California as the source of water supply for San Francisco, holding with the Sierra Club and others that the needs of that city could have been satisfied without the invasion of that particular watershed. Familiar with the High Sierras, Schwarz was also interested in coastal California, and was an active supporter of the Save-the-Redwoods League, of which he was a life member.

In 1925 Schwarz bought and gave to the California State Redwood Park system, through the Save-the-Redwoods League, the Henry Solon Graves Grove of redwoods, ten miles south of Crescent City in Del Norte County. Scenically, fronting as this stand of giant trees does on the Pacific Ocean, it is one of the finest groves in the redwood region. The

original gift comprised 157 acres. This was subsequently enlarged by a further gift from Mr. Schwarz of certain adjoining lands needed to round out the Graves Grove as an administrative unit.

A little later he gave to the Redwood Park system another grove, named in honor of Professor James W. Toumey, of Yale University, on the south fork of the Eel River in Humboldt County. This grove includes stretches of water and a fine bathing beach. And more recently he had constructed a stone over-night lodge on the Muir Trail, at a cost of several thousand dollars.

Other gifts of even more direct interest to foresters stand to Mr. Schwarz's credit. To Harvard University he gave as an addition to the Harvard Forest at Petersham, Mass., with certain funds for its maintenance, a tract of wooded upland, which it had been his hope to develop as a demonstration of how forest aesthetics could be applied in practice. To Yale University he made in 1927 a liberal contribution for the purchase of a compartment of the Yale Demonstration and Research Forest at Keene, N. H. This is now called the Schwarz Compartment. He likewise aided in the purchase of land for park purposes at Mt. Carmel, near New Haven, Conn. and within a month of his death he made to Cornell University a substantial gift toward the erection of a foresters' lodge or headquarters building on the Arnot Forest, the tract near Ithaca that is used as a college forest by the Cornell Department of Forestry.

Precise in his ways, meticulously exact as to details, and with certain characteristic idiosyncrasies that only endeared him the more to his friends, one had to know Schwarz well really to understand him. By those who had that privilege he will ever be remembered as a man of the finest sensibilities, keenly alive always to the beauties of nature and to the best in human life, a loyal and understanding friend, and in the highest sense of that abused word, a true gentleman. G. Frederick Schwarz held a unique place among American foresters. In his passing the profession of forestry has suffered a distinct loss.

RALPH S. HOSMER,
*Cornell University.*

## JOHN W. STEPHEN

1863-1931

John Wallace Stephen, 67, Professor of Silviculture and head of the Department of Silviculture at the New York State College of Forestry, died very suddenly at his home, 143 Redfield Place, Syracuse, N. Y., on January 2, 1931.

Professor Stephen was the senior member of the faculty of the New York State College of Forestry, joining the staff of the College as Assistant Professor of Silviculture in 1912, being advanced to full Professorship and becoming head of the Department of Silviculture in 1915. In addition to his teaching duties, he carried the oversight of the college nurseries at the Rockwell Springs Experiment Station just south of the City of Syracuse.

Professor Stephen had been in full

charge of his numerous activities up until a short time before his death. In October he underwent a minor operation, from which he made a slow recovery, but was discharged from the hospital and was in process of recuperation and supposedly well on the road to recovery. He had, in fact, visited his office in the College of Forestry but a few hours before his death. The immediate cause of his death was Agina Pectoris.

Professor Stephen was born of Scotch parentage on May 21, 1863, on a farm in Amada township, McComb County, Michigan. He was educated in the public schools of that county and was graduated from the Michigan State Normal College in 1889. In 1915 this College bestowed upon him the honorary degree of M. Pd. The years from 1889 to 1904 were spent as a teacher and principal in the secondary schools in Washington State and in northern Michigan. As a result of his life in northern Michigan, he became interested in forestry and decided to enter that profession. In 1905 he entered the University of Michigan, from which institution he received the degree of A. B. in 1907, and in 1909 completed his work in the School of Forestry with the degree of M. S. F. Immediately upon graduation he became Assistant Forester of New York State. In connection with his duties in this position, he organized and developed a State Forest Nursery at Salamanca and directed forest planting operations in the Saranac Lake district. He later made woodlot surveys in Oneida and other counties and also carried on an intensive investigation of the basket willow industry of the State. When the New York State College of Forestry was organized at Syracuse in 1912, he joined the staff as one of the first members of its faculty and remained with this institution until his death.

Professor Stephen contributed at various times to scientific forestry literature, among his publications being the following: "Forest Conditions in Oneida County," 1910; "Basket Willow Culture in New York State," 1911; "The Basket Willow," 1914; "Making the Best Use of Idle Lands in New York State," 1917.

During the summers of 1916 and 1919, he was employed by the U. S. Forest Service in Wisconsin on White Pine Blister Rust Eradication. While on sabbatical leave during 1921-22, he worked with the Forest Service and also taught at the University of Montana at Missoula. A second sabbatical leave in 1928-29 was spent in travel through the Southern United States and Europe. He visited forests and nurseries in the Carolinas, Florida, France, Italy, Switzerland and Germany. His European trip was unhappily cut short by the death of his wife, which occurred in Nice, France, in July, 1928.

Professor Stephen was a Senior Member of the Society of American Foresters, a member of Phi Kappa Phi scholastic fraternity, and Sigma XI honorary scientific fraternity.

He was married to Grace Paton at Almont, Michigan, in 1894 and was the father of two children, both of whom survive him. They are his son, Paton Carlyle, University of Michigan—1917, now a mechanical engineer, located at Akron, Ohio, and a daughter, Kathryn, Syracuse University—1921, later a stu-

dent at Oxford University, England, and with whom he made his home at the time of his death.

Professor Stephen was an active citizen in the everyday life of his community and was universally admired and respected as a man as well as a scientist. He was an Independent in politics and for many years was an Elder of the East Genesee Presbyterian Church of Syracuse.

The passing of John Stephen in point of service the Dean of the Faculty of the New York State College of Forestry, came as a distinct shock to the students and faculty of the College. Because of his sympathetic and congenial personality, both within and without the classroom, he was "Uncle John" to the student body and to his colleagues on the Faculty, a name which will indicate the esteem and affection in which he was held. Because of his long and faithful service, broad experience, and outstanding character, his memory will be enduring with all those connected with the institution during the period of his activity.

R. P. PRICHARD,
*N. Y. State College of Forestry.*

## SHERMAN ELECTED FELLOW

Mr. E. A. Sherman, since 1920 Associate Forester of the U. S. Forest Service has been elected to the grade of Fellow. He has been with the Forest Service since 1903 and was elected to the Society of American Foresters in 1916.

The tellers were Messrs. W. H. Von Bayer and A. E. Fivaz.

## COUNCIL MEETING

The regular annual meeting of the Council was held at the Wardman Park Hotel on December 28. Those present included President Paul G. Redington, Vice-President Major John D. Guthrie, Secretary-Treasurer E. Morgan Pryse, Major R. Y. Stuart, W. G. Howard, Prof. R. S. Hosmer, C. R. Tillotson, W. R. Hine, Executive Secretary and Miss L. Audrey Warren, Business Manager.

President Redington read a telegram of regret from Dean, C. D. Howe, who being under the doctor's care was unable to come.

Proceeding with the business of the meeting, President Redington presented the request of the Gulf States Section and various other organizations, that the Society of American Foresters meet in New Orleans in 1931.

The invitation was favored by the several Council members since the A. A. A. S., will meet there at the same time. It was thought, moreover, that the South would be of great interest to many foresters and finally the Southern Sections have grown in numbers and could develop a most interesting program.

A proposal was received urging the addition of another section to the Forest Research (McSweeney-McNary) Act. The section would provide specific authorization for funds for research in erosion and streamflow.

The Council went on record as recommending the addition of this section to the Forest Research Act.

A communication was received from

the American Forestry Association asking for consideration by the Society of the proposed Everglades Park in Florida.

A request was received from D. G. White, Trade Extension Manager of the Appalachian Hardwood Club, asking that that the Society undertake a study of certain wood utilization problems.

It was the opinion of the Council that the problems proposed were being studied by the National Wood Utilization Committee, or would fall within the scope of the National Timber Conservation Board. The matter was laid on the table.

The Council considered ways and means of enlisting the help of the members of the Society to develop advertising for the JOURNAL. It was decided that the Executive Secretary should work out a plan with the Section secretaries and, on the authority of the Council, enlist the best men in each Section.

A resolution of thanks to W. S. Carpenter was unanimously passed by the Council for the great amount of time, thought and funds which have been given by him towards increasing the volume of advertising in the JOURNAL.

The matter of qualification for Associate Members was discussed at some length. It was decided to approve the amendment to the By-laws to provide that an Associate Member should have the qualification already set up in the Constitution and By-laws and that also he be endorsed by at least three sections "as having shown substantial interest in forestry and having participated in its advancement." It was insisted the endorsement of the Sections be not perfunctory on the request of another section but based on knowledge of the applicant.

It was pointed out that there is a general request for liberality with regard to admitting Junior members. The Council seemed in full accord with the liberality thus far requested as indicated by the applications received. Men who failed of election to Junior grade failed because of lack of evidence of qualifications rather than because of the nature of their work.

The question of Student membership was again considered but received little support since this matter had been previously considered and rejected.

The matter of a certificate of membership in the Society was considered very favorably. It was decided that the Executive Secretary should work out complete figures as to type, size, form, etc., and present them for action to the Finance Committee for final action.

Very fine letters of appreciation were received from the newly elected corresponding members, Jean J. Jagerschmidt of France, and Adam Schwappach of Germany.

A proposed personnel record of members was discussed in some detail. A few corrections and changes were made in the proposed form and the matter was then left to the Executive Secretary for completion and subsequent handling.

The Council passed a resolution of thanks for the service rendered the Society and others by the preparation of the Cumulated Index by Messrs. Korstian, Buell and Rhoades of the Appalachian Section.

W. G. Howard urged the Council to go on record as favoring additional Federal appropriation to clean out in-

festations of the Gypsy Moth in New England. He discussed the valuable work being done by the State of New York in maintaining a barrier zone protecting the hardwoods to the West and South, and urged the importance of the problem from a national standpoint.

It was suggested that the JOURNAL should carry notice of examinations, including the United States Civil Service, the State Services, and others.

It was suggested and approved by the Council that the name of the Executive Secretary should appear in the JOURNAL with the officers of the Society.

A resolution was passed by the Council calling upon the United States Forest Service and the United States Biological Survey to issue technical leaflets or very brief statements on current projects because of the great need for information concerning the work being done, pending the issuance of final bulletins on such projects.

President Redington briefly commented on the new National Timber Conservation Board and the importance of the many subjects which would come before such a board and mentioning the fact that the Society had been recognized in the selection of its president as a member of this Board. He also indicated that forestry would be adequately represented on the Advisory Council which would be organized to assemble the facts for the Board.

### SPEED IN PUBLICATION PROMISED

A resolution approved at the recent annual meeting of the Society, concerned more prompt publication of the results of studies by federal officers. A copy of this resolution was called to the attention of Mr. M. S. Eisenhower, Director of the Information Bureau of the U. S. Department of Agriculture, and he replied as follows:

"I am glad to have the resolution you sent me indicating the desire of the Society of American Foresters to have progress reports on forest research printed regularly.

"I am now making arrangements with Major Stuart to have this done."

### SOCIETY SUPPORTS BILL FOR A NATIONAL ARBORETUM

A letter signed by W. R. Hine endorsing the National Arboretum was filed on January 12 with the House Committee on Agriculture by G. H. Collingwood, Forester of the American Forestry Association. The opportunity to express the interest and support of the Society was afforded by the public hearings on H. R. 12717 to authorize an appropriation of $200,000 with which to complete the purchase of the necessary lands.

The National Arboretum will occupy approximately 425 acres in the northeastern quarter of the District of Columbia. It includes a variety of planting sites stretching from the shores of Anacostia River to the heights of Mt. Hamilton and will afford a place where the Department of Agriculture may maintain specimens of all trees and shrubs adapted to the climate of this region. Of

even greater importance are the prospects for the observation of special strains of trees and for the development of studies in plant breeding as applied to trees.

## Third Annual Meeting of the California Section

The Third Annual Meeting of the California Section was held in the auditorium of the Pacific Gas and Electric Company Building in San Francisco on December 19, 1930. The registered attendance was 213, ninety-two of whom were members of the Society. Not only were there more non-members than members, but the federal group was in the minority! The following figures give a classification of the attendance:

| | |
|---|---|
| Australian Forest Service | 1 |
| Students | 4 |
| (A few students temporarily employed by the Forest Service are included under the latter heading) | |
| Employed by Counties | 6 |
| U. C. teaching staff | 6 |
| Federal, other than Forest Service | 7 |
| Miscellaneous | 7 |
| Private employ | 19 |
| State Division of Forestry | 64 |
| Forest Service | 99 |
| Total | 213 |

This is the third successive year that the California Section held a very successful gathering. The Section holds monthly meetings from October to April and sometimes May, but the December meeting has become a "grand" meeting staged primarily to bring together more men from outside the San Francisco Bay region. It is now looked forward to by the field men for the opportunity of keeping abreast of forestry progress in California and to develop wider acquaintanceship among foresters.

The theme of the meeting was state forestry and its problems, which accounts for the large representation of state rangers, fire wardens, and other state officers.

The meeting was called to order at 9:00 o'clock, A. M., by Chairman E. I. Kotok who introduced Professor Willis Linn Jepson, professor of botany at the University of California. Professor Jepson was one of the pioneers in forestry education in California and maintains an intense interest in the subject. He introduced his subject with a brief lecture with lantern slides, touching on forest conditions in Palestine where he has recently made studies. Of particular interest was his description of the Cedar-of-Lebanon forests and the recent discovery of many stone markers dating to Roman times which marked out the boundaries of the forest of that period. Drawing a lesson for America from these Palestinian conditions, he spoke forcefully upon his topic, "Go to Meet the Enemy; Do Not Wait for Him," in which he encouraged foresters to go to it, whatever their problems may be, and not wait for the problems to force themselves upon a profession unwilling to attack them.

State Forester Merritt B. Pratt next followed, talking on the subject, "The State Forestry Service; Its Growth in the Past and Present Objectives." Mr. Pratt pointed out that forestry as a state enterprise actively started as long ago as 1885, but the early boards of forestry degenerated into merely political boards and in the early nineties were abolished.

In 1905 a State Board of Forestry was revived and a state forester was appointed. These offices have been continued down to the present time without a break, although their administrative relationships to other parts of the state government have not been uniform during that entire period. The history of the board and of the state forester in this period of twenty-five years has been a continual fight against fire. In the earlier days the situation was most unsatisfactory. The state forester had to do all his work through voluntary cooperation and assistance from the counties. Not until 1920 was a state appropriation made for fire protection, when $25,000 was appropriated for the biennium. Since that time, however, there has been a continued increase in appropriations, and little by little an effective fire protection organization has been built up, which is now measurably close to the goal that has been set for it. With the organization that is desired, it is believed that reasonable protection will be afforded, especially to the foothill lands outside the National Forests.

Professor F. S. Baker, of the University of California, continued the program of discussing state forestry with "The Place and Responsibility of the State Division of Forestry; a Critical Review." He took the viewpoint that the place of the State Division of Forestry could best be shown by studying the problems that had confronted the state forester in the last twenty-five years. He found that the points most frequently brough out in the annual reports dealt with five lines of work—fire protection, forest planting, acquisition of lands, research, and private forestry. In the case of fire protection, the problems have been so acute that the energies of the state organization have been pretty closely limited to this one field and accordingly they have accomplished a great deal. In the other four fields, attention has been more sporadic, and Professor Baker believes that nothing has been shown in the past to indicate that at the present time either forest planting or acquisition of lands is an essential part of a state program that needs to be built up, although the state should endeavor to try to comply with the needs of the public in both these respects. In view of the large research program carried on in California by the federal government, it is not thought that the state organization should try to supplement or duplicate this work, but should, in effect, hire the federal experiment station to do its research. In cases where independent checks are desired, the university can probably serve the state adequately. The question of private forestry has cropped up frequently and sometimes it has been ignored and at other times it has been dealt with aggressively, while at the present time coöperation is the policy. This may satisfy the needs of the present, but the state should certainly look carefully into the future and lay foundations for a satisfactory state policy in this regard.

Following this paper, six papers were given covering the relations of the State Division of Forestry to outstanding forest problems. H. S. Gilman, member of the State Board of Forestry, spoke first on water conservation, the main contention of his paper being the need of a sound state policy based on known

facts. He pointed out that one prominent engineer stated that seventy-five per cent of all the state's water reach the ocean within forty-five days after it falls, while another has stated that fifty to seventy-five per cent of the precipitation is consumed by the native vegetation. As a result of these conflicting technical statements, we find water users dividing among themselves even on single drainage areas with one faction advocating brush burning so that more water will run off, and the other faction protesting even against the cutting of timber on the National Forests because of the detriment to the water crop.

The relation of the state to industrial forestry was developed from the standpoint of the lumberman by Major Swift Berry, assistant general manager of the Michigan-California Lumber Company, who advocated a program of education by the state through men on the ground. If lumber companies could have the assistance of state officers in their brush burning, and if these state men would assist in developing experiments to determine cheapest methods of brush disposal, the state would not only contribute materially to the problems of fire protection, but would develop an effective entering wedge of coöperation and good fellowship that would serve to stimulate other and better forestry practices on the ground.

Assistant State Forester W. B. Rider discussed the state ownership of forest lands, pointing out that a certain amount of this is almost necessary. The state has, at the present time, a compact body of such lands, but not yet under effective administration.

California presents a peculiar situation in that it has a single county which spends more for forestry than the entire state. Mr. Spence D. Turner, county forester of Los Angeles County, discussed the relationship of the county to the state. The practice of forestry in southern California by units as small as a county has many drawbacks, for the development of forestry in the different counties is not uniform and occasionally county lines cut across major watersheds. An unfortunate difference in policy accordingly develops which could be ironed out if the counties could act as a unit or if the state could take over the management of these forested lands. At the present time, considering the enormous appropriations for forestry by southern California counties, these counties do not feel that they can take the risk of relinquishing control to the state without more assurance than they have at present that their intensive protection policies will be carried out. Therefore, in spite of its obvious disadvantages, it appears that county forestry will have to continue, although it should be in close coöperation with the state.

Assistant Regional Forester J. H. Price discussed the Clarke-McNary Act and the relation of the federal government to California's state forest program. He pointed out that the coöperative provisions of the Clarke-McNary Act have worked out very well. As long ago as 1919 California obtained its first federal allotment of $3,500 under the Weeks Law. At the present time, the state's allotment under the Clarke-McNary Act is $147,000. State appropriations are about $300,000, while coöperative funds made available by

counties and private timber owners amount to about $250,000. Under these appropriations a very good fire protection system has been developed and a noticeable reduction of fires upon operating lumbering areas has been achieved. Mr. Price discussed in considerable detail whether regulation by the federal government was the next step to be taken. He pointed out that the use of tractors and the present economic depression has done a great deal in the last few years to make the private operators leave the smaller material standing. This, coupled with better fire protection, has done a great deal toward better silvicultural conditions on private cut-over lands. But he brings up the question of what will happen in case this economic incentive to silviculture falls down. He believes the policy to be followed is one to be worked out by foresters and lumbermen, but does not feel that it involves federal intervention. It is primarily a state problem and is becoming more and more a state affair as time goes on. For the present, it looks as though nothing was urgently required along this line and that coöperation can still accomplish a great deal.

The sixth paper of the series was given by Extension Forester Woodbridge Metcalf, who talked about his own job. He described the fire prevention campaign and work of the 4-H Club, and closed his talk with a strong plea that foresters follow Professor Jepson's advice given at the opening of the session and go and meet the enemy without waiting for him. On analyzing the situation, he concluded that the enemy was no longer external, if it ever had been; it was internal apathy and laziness, more than anything else, that foresters needed to combat.

The formal sessions closed with a scholarly resumè by Dr. E. P. Meinecke.

The grand finale took place in the evening at the St. Francis Hotel, where two hundred and four foresters, lumberjacks, and a sprinkling of gentlemen pulled their chairs up to the festive board to partake of rations and to witness a Shakespearean drama and other more or less high-class entertainment.

M. R. Brundage,
*Secretary, California Section.*

## FORTHCOMING EVENTS

31st Annual Meeting
Society of American Foresters
December, 1931
New Orleans, La.

Annual Meeting
Pacific Coast Forestry Conference
(Western Forestry and Conservation Association)
March 19, 20, 21, 1931
Davenport Hotel, Spokane, Wash.

Third Soil and Water Conservation Conference, June, 1931
Fayettesville, Ark.

American Forestry Association
June 2-4
Grove Park Inn, Asheville, N. C.

Section secretaries are welcome to use this box for announcing their meetings. Copy should be in the hands of the Editor or Executive Secretary one month before date of publication.

## Announcement of Candidates for Membership

The following names of candidates for membership are referred to Junior Members, Senior Members, and Fellows for comment or protest. The list includes all nominations received since the publication of the list in the February Journal, without question as to eligibility; the names have not been passed upon by the Council. Important information regarding the qualifications of any candidate, which will enable the Council to take final action with a knowledge of essential facts, should be submitted to the undersigned before April 10, 1931. Statements on different men should be submitted on different sheets. Communication relating to candidates are considered by the Council as strictly confidential.

### FOR ELECTION TO GRADE OF JUNIOR MEMBER

| *Name and Education* | *Title and Address* | *Proposed by* |
|---|---|---|
| Balch, A. P.<br>Univ. of Idaho, B. S. F., 1929. | Forest Ranger, U. S. F. S. St., Anthony, Idaho. | Intermountain Sec. |
| Brown, William E.<br>Mont Alto, B. S. F., '27; Yale. | Forester, Penn. Dept. of Highways, Sellersville, Penn. | Allegheny Sec. |
| Burris, Michael M.<br>Univ. of Washington, B. S. F., '15. | Civil Landscape Engineer, 15 Tenafly Road, Englewood, N. J. | Allegheny Sec. |
| Byrd, Zeke B.<br>Univ. of Ga., B. S. F., '25. | Forest Ranger, Nantahala Natl. Forest, Andrews, N. C. | Appalachian Sec. |
| Christensen, Ivan<br>Utah St. Agri. Col., B. S., 1929. | Forest Ranger, La Sal Natl. Forest, Monticello, Utah. | Intermountain Sec. |
| Connaughton, Charles A.<br>Univ. of Idaho, B. S. F., '28. | Senior Forest Ranger, U. S. F. S., Bosie, Idaho. | Intermountain Sec. |
| Cowan, William Foster<br>N. Y. St., B. S., 1927. | Junior Engineer, American Creosoting, Co., Bogalusa, La. | Gulf States Sec. |
| Cummings, Lewis A.<br>Univ. of Idaho, B. S., 1925, Yale, M. F., 1929. | Ranger, Rio Grande Natl. Forest, South Fork, Colo. | Central Rocky Mt. Sec. |
| Easley, L. T.<br>N. Y. St. Ranger Col. | Member, Forestry Staff, West Va. Paper & Pulp Co., Georgetown, S. C. | Appalachian Sec. |
| Eyman, William G., Jr.<br>Penn. St., B. S., 1930. | District Sales Manager, Howard Tree Expert Co., Pittsburgh, Pa. | Allegheny Sec. |
| Hottenstein, Wesley L.<br>Pa. St., B. S., 1929. | Division Forester, Dept. of Highways, Franklin, Pa. | Allegheny Sec. |
| Klemme, Marvin<br>Univ. of Washington, B. S., 1930, almost a Masters Degree. | Timber Salesman, Harney Natl. Forest Custer, S. Dakota. | Central Rocky Mt. Sec. |
| McKeller, Alfred Donald<br>La. St. Univ., B. S. F. | Junior Forester, U. S. F. S., Elkins, West Virginia. | Gulf States Sec. |
| Loring, John Malcolm<br>Bates Col., B. S., 1928; Yale, M. F., 1930. | Junior Forester, Pike Natl. Forest, Colorado Springs, Colo. | Central Rocky Mt. Sec. |

| *Name and Education* | *Title and Address* | *Proposed by* |
|---|---|---|
| Pickett, Ray<br>Utah St. Col. 1 yr. | Senior Ranger, U. S. F. S., Spencer, Idaho. | Intermountain Sec. |
| Powers, Florian E.<br>Oregon St. Col., B. S. F., 1929. | U. S. Forest Service, Ogden, Utah. | Intermountain Sec. |
| Price, Curtis E.<br>Oregon St. Col., B. S. F., 1928. | Junior Forester, U. S. F. S., Ogden, Utah. | Intermountain Sec. |
| Riddle, Wallace M.<br>part time at B. Y. A. | Forest Supervisor, Powell Natl. Forest., Panguitch, Utah. | Intermountain Sec. |
| Shank, Henry Mercer<br>Correspondence Course in Civil Engineering. | Chief, Maps & Surveys, U. S. F. S., Ogden, Utah. | Intermountain Sec. |
| Stoller, Karl M.<br>Union Col., B. S., 1916; Yale, M. F., 1930. | Junior Land Examiner, U. S. F. S., Russellville, Ark. | Ozark Sec. |
| Ripper, Edward Ernest<br>Penn. St., B. S. F., 1930. | Junior Forester, Ouachita Natl. Forest, Hot Springs, Ark. | Ozark Sec. |
| Watson, Carl H.<br>Mont Alto, B. S. F., 1927. | Division Forester, 603 N. Beatty St., E. Liberty, Pa. | Allegheny Sec. |
| Whittemore, James A.<br>Univ. of Maine, B. S. F. | Assistant to Woods Supt. Southern Bag & Paper Co., Jonesboro, La. | Gulf States Sec. |
| Wogensen, Adolph<br>Univ. of Minn., B. S. F., 1929. | Ranger, U. S. Indian Service, Cherokee, N. C. | Appalachian Sec. |

FOR ELECTION TO GRADE OF SENIOR MEMBER

| | | |
|---|---|---|
| Adams, John A.<br>Howard Col. | Supervisor of Manzano Natl. Forest, Albuquerque, N. M. | Southwestern Sec. |
| Bedford, J. M.<br>Beloit Col. Uni. of Mich., A. B., 1909, M. S. F., 1910. | General Manager, Saginaw & Manistee Lumber Co., Williams, Ariz. | Southwestern Sec. |
| Benedict, Miller S.<br>Univ. of Nebraska | Forest Supervisor, Sawtooth Natl. Forest, Hailey, Idaho. | Intermountain Sec. |
| DeMoisy, Charles Jr.<br>Proctor Academy, 4 yrs. | Forest Supervisor, Uinta Natl. Forest, Provo, Utah. | Intermountain Sec. |
| Miles, Clark<br>Univ. of Minn. 2 yrs. | Assistant Forester, Payette Natl. Forest, Room 406, McCarty Bldg., Boise, Idaho. | Intermountain Sec. |

W. G. HOWARD,
*Member of Council in Charge of Admissions.*

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| T. T. MUNGER | Dec. 31, 1931 | RALPH S. HOSMER | Dec. 31, 1933 |
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W. G. HOWARD

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